SAMPLING AND ANALYSIS PLAN - VOLUME I
FIELD SAMPLING PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. On July 27, 2005, the EPA issued a modified Unilateral Administrative Order (UAO), requiring the potentially responsible parties to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. This Field Sampling Plan (FSP) has been prepared as Volume I of a Sampling and Analysis Plan (SAP) in accordance with Paragraph 27.a of the Statement of Work (SOW) for the RI/FS included as an Attachment to the UAO. The FSP has been prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow) (collectively referred to as Respondents in the UAO).

The FSP format and elements have been developed in accordance with guidance developed by the United States Environmental Protection Agency (EPA, 1988). The plan presents specific sampling locations, equipment and procedures to be used during the RI/FS. A general description of RI/FS activities is provided in the RI/FS Work Plan (PBW, 2006a). Quality assurance/quality control (QA/QC) policies, organization, objectives, functional activities, and other specific QA/QC activities are described in Volume II of the SAP, the Quality Assurance Project Plan (QAPP) (PBW, 2006b).

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

The Site is located about three miles northeast of Freeport, Texas in Brazoria County at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west.

The Site is located between Galveston and Matagorda Bays and is situated along approximately 1,200 feet of shoreline on the Intracoastal Waterway. The Intracoastal Waterway is a coastal shipping canal that extends from Port Isabel to West Orange on the Texas Gulf Coast.

Marlin Avenue divides the Site into two areas (Figure 2). For the purposes of this work plan, it is assumed that Marlin Avenue runs due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses and will continue to be used for commercial/industrial purposes in the future. Adjacent property to the north, west and east of the northern portion of the Site is unused and undeveloped. Adjacent property to the east of the southern portion of the Site is developed and currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south.

The South Area includes approximately 20 acres of upland that was created from dredged material from the construction of the Intracoastal Waterway. Some of the North Area is upland created from dredge spoil, while most of this area is considered wetlands (RI/FS Work Plan, Figure 3 (PBW, 2006a)). The wetlands on and north of the Site are estuarine, intertidal, emergent, persistent, and irregularly flooded.

The Intracoastal Waterway supports barge traffic and other boating activities. The area near the Site is regularly dredged and, as noted by the United States Fish and Wildlife Service (USFWS), shoreline habitat is limited (USFWS, 2005).

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The Site geology consists predominantly of Quaternary alluvium and "fill and spoil" from the construction of the Intracoastal Waterway (Barnes, 1987), as shown on Figure 3. The alluvium consists of clay, silt, sand and gravel, with organic material abundant in the soils. The fill and spoil material consist of dredged material "for raising land surface above alluvium and barrier island deposits and creating land" (Barnes, 1987). The spoil material is highly variable with mixed mud, silt, sand and shell, with the reworked spoil mostly sandy and moderately sorted (McGowen, 1976).

Underlying the alluvium unit is the Beaumont Formation, which consists of clayey soils with interconnected, alluvial sand channels and barrier island beach deposits encountered in the formation. The Beaumont Formation is about 100 feet thick. The Lissie and Willis Formations underlie the Beaumont Formation. The Lissie Formation consists of interbedded sands, silts, and clays and is about 200 feet thick, overlying the Willis Formation, which consists of gravel, sand silt, and clay. The Alta Loma Sand is part of the Willis Formation and is the thickest sand sequence in the Willis Formation. The base of the Alta Loma Sand in southeast Brazoria County is about 1,200 feet below mean sea level (MSL) (Sandeen, 1982).

The two primary hydrogeologic units beneath the Site are the Chicot and Evangeline Aquifers. The Chicot consists of the Willis, Lissie, and Beaumont Formations. The Evangeline Aquifer consists of sands of the Goliad and Fleming Formations. The Chicot Aquifer is subdivided into two zones: the Lower and Upper Chicot. The Lower Chicot in Brazoria County generally includes the Alta Loma Sand unit, which is about 400 feet thick in the Freeport area (Sandeen, 1987). The Upper Chicot is made up of interconnected sands that are found within 300 feet below ground surface.

The main source of groundwater in the area is from the Chicot Aquifer. The Lower Chicot can produce as much as 3,000 gallons per minute (gpm); however the water contains a large amount of slightly saline water (1,000 to 3,000 mg/L total dissolved solids (TDS)). The Upper Chicot is the most-widespread fresh-water aquifer in Brazoria County, and wells completed in Upper Chicot sands at least 50 feet thick can yield 500 to 1,000 gpm. However, in some areas along the coast the interbedding of saline water with fresh water has been encountered (Sandeen, 1987).

The Site and vicinity currently receive water via pipeline from the City of Freeport. During the early operation at the Site, water was supplied for barge cleaning operations by two on-site water wells. It was reported that one of these wells was located adjacent to the front entrance gate south of Marlin Avenue (TNRCC, 2000b); however, neither of these wells could be located in July 2005.

The closest water well (TWDB ID 81-06-303) identified near the Site is located on the adjacent property west of the Site at a former marina. The total depth of the well is reported to be 199 feet below ground surface. Water quality from the well in 1969 showed a TDS concentration of 1,382 mg/L with the depth to water about 67 feet (TWDB, 2005). In July 2005 this well was observed to be present, but was abandoned with the drop pipe unsecured.

The previous monitoring wells installed at the Site were installed in shallow water-bearing sands less than 50 feet below ground surface. Three monitoring wells, HMW-1, HMW-2, and HMW-3 (Figure 2) that were installed in January 1989 were completed in a sand unit about nine feet thick, with the top of the sand encountered about nine feet below ground surface (Hercules, 1989).

2.3 POTENTIAL SOURCE AREAS (PSAs)

As detailed in Section 3.2 of the RI/FS Work Plan, 13 Potential Source Areas (PSAs) have been identified at the Site based on the Site operations history, previous investigations and existing data as described in the RI/FS Work Plan. These PSAs are listed below and shown on Figure 4.

Former Aboveground Storage Tank (AST) Tank Farm Area	Sand Blasting Areas	Former Product Storage Tank Area
Pipelines	Welding Area	Former Gasoline Storage Tank Area
Former Surface Impoundment Area	Dry Dock Area	Lot 21 Area
Former Wash Water Storage Tank Area	Surface Drainage Areas	
Electrical Shed	Former Septic Tank Areas	

2.4 CONCEPTUAL SITE MODEL

As detailed in the RI/FS Work Plan Section 3.3, preliminary Conceptual Site Models (CSMs) were developed for both human health and ecological receptors for the Site. Using the CSMs, a list of site-wide chemicals of interest (COIs) was developed from the RI/FS Work Plan based on Site historical information regarding chemicals potentially used or handled at the Site, existing Site data, and discussions with EPA during the scoping phase meeting for this Site. As such, COIs for the Site generally include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). It should be noted that the term COI has been used to indicate, in most PSAs, the full suite of analytes.

Based on an evaluation of the potentially complete pathways identified in the RI/FS Work Plan CSMs, and an analyses of the information needed to assess the completeness of these pathways, data needs were identified to satisfy the objectives of the RI/FS and to establish the objectives set forth in this FSP.

3.0 SAMPLING PLAN

As described in the RI/FS WP, the overall objective to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives. The technical approach for meeting these objectives is described in detail in the RI/FS Work Plan. The objective of the RI/FS FSP is to define in detail the sampling and data gathering methods needed to obtain data that are representative of site conditions and will be used to define the nature and extent of contamination and provide input to the risk assessment.

Based on the Data Quality Objectives (DQOs) detailed in the QAPP, the sampling plan design for the RI/FS consists of both judgmental and systematic sampling to satisfy the project objective of defining the nature and extent of contamination. The samples per media required for this investigation are summarized in the Sample Design Collection Worksheet (Table 1). The worksheet contains the elements needed to support the decisions for RI sampling design to meet data requirements for the risk assessment.

The field activities detailed in this FSP will be conducted in a general phased approach as discussed for each media in the section below. The proposed sample locations detailed in this FSP are initial locations that may be modified based on field conditions. Additional samples may be needed for nature and extent based on the initial data obtained.

3.1 LOCATING PROPOSED SAMPLE STATIONS

Sample stations will be located in the field using the coordinates extrapolated from locations on the Site maps (Figure 5 for the North Area and Figure 6 for South Area). A differential global positioning satellite (GPS) receiver will be used to locate the proposed sampling sites in the field. The GPS unit will utilize real-time corrections to achieve the horizontal and vertical coordinates with sub-meter accuracy. Accuracy of the sample locations is important to mapping analytical results, so a relatively high degree of confidence is needed as to where each sample is collected, and if needed, the sample location can be reacquired for future efforts. The desired coordinates will be programmed into the GPS and the receiver can then guide the user to the desired coordinates. However, the proposed sampling locations may be modified in the field based on field conditions and professional judgment.

3.2 FORMER SURFACE IMPOUNDMENT CAP EVALUATION

The objective of this evaluation is to assess the construction materials and thickness of the caps constructed on the former surface impoundments in order to evaluate the potential for transport of VOCs as discussed in the RI/FS Work Plan. The following activities shall be performed as part of this evaluation:

- Advance four soil borings within the former surface impoundments for a geotechnical evaluation, as shown on Figure 5. Borings will be drilled and continuously sampled to a depth of five feet or to the base of the cap material, whichever occurs first, as detailed in Section 5.4.3.
- Collect one representative soil sample from each boring for laboratory geotechnical analyses detailed on Table 2 (Percent Passing No. 200 Sieve, Atterburg Limits, and vertical hydraulic conductivity).
- Perform a field inspection of the cap area, including observation of desiccation cracks, erosion features and overall surface condition. The inspection will be documented following the field document procedures detailed in Section 6.3.

3.3 SURFACE GEOPHYSICS EVALUATION

The objective of this evaluation is to attempt to locate former pipelines at the Site that may have been used to transport product material or wash water associated with the barge cleaning process from the barges and former AST tank farm area to the former surface impoundments or the wash water storage area. An electromagnetic (EM) metal detector, Geonics EM-61 or equivalent meter, and an EM radiodetection (RD) meter will be used to record magnetic anomalies caused by buried metal. Transects will be surveyed across the PSAs as shown on Figure 7. Two areas have been identified for conducting the EM surveys:

- Pipeline corridor for pipeline from AST Area to Former Surface Impoundment Area; and
- Pipeline corridor between AST Area and Former Wash Water Tank Area.

Before conducting the EM-61 survey, the RD meter will be used to identify potential buried pipes. The EM-61 MK2 meter will be used to support the RD meter data and to survey larger areas. The EM-61 MK2 transects for the pipeline areas will be oriented perpendicular to the assumed pipeline layout. As an example, the pipeline that was believed to transport wash water

from the barge cleaning process to the Former Surface Impoundment Area likely was oriented north-south. Therefore, the EM transects will be oriented east-west. The spacing of the EM transects for the pipeline surveys will be about 50 feet with readings collected approximately every 5 feet. Transects will be surveyed in the field using the GPS meter by recording northing and easting coordinates. If any anomalies are identified in the field, additional transects may be added to further identify and delineate the anomalies.

3.4 SOIL INVESTIGATION

The objective of the soil investigation is to evaluate the lateral and vertical extent of COIs in soils as detailed in the RI/FS Work Plan. Soil samples will be collected following the sampling procedures detailed in Section 5.4.

For the initial phase of the investigation, the following four sets of soil samples will be collected as part of this investigation**:**

- PSA-based soil sample locations;
- Random systematic grid-based soil sample locations;
- Residential surface soil investigation samples; and
- Soil fate and transport characterization samples.

In addition, background soil samples may also be collected if needed.

3.4.1 PSA-Based Samples

Soil samples will be collected at each PSA listed in Section 2.3 using both judgmental and random systematic grid-based locations. The proposed soil sample locations within each PSA are presented on Figures 5 and 6 and the total number of sampling stations and samples in each PSA are summarized in Table 2. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective Preliminary Screening Values (PSVs) as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

The proposed judgmental-based sample locations within the PSAs were selected using existing data or by identifying locations within the PSA where the potential for a release may be more likely (e.g., near the sump within the former AST tank farm area). The locations of the actual judgment-based sample stations may be adjusted based on field observations and professional judgment (e.g., an observed seep area below the former AST tank farm containment wall).

3.4.2 Random Systematic Grid-Based Soil Sample Locations

For any areas within a grid that are not sampled as part of the PSA sampling program described above, random systematic grid-based soil samples will be collected on a 200-foot grid spacing in the North Area (Figure 5) and on a 100-foot grid spacing in the South Area (Figure 6). Soil samples will not be collected from grid-based locations falling within the wetland areas (shown on Figure 3 of the RI/FS Work Plan) or obviously observed to be wetland areas during sampling. Rather, sediment samples will be collected from those locations as described in Section 3.8, below. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective PSVs as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

3.4.3 Background Soil Samples

Should background soil samples be needed for the PSV comparisons described in the RI/FS Work Plan, nine background soil samples will be collected on a grid spacing within the background soil sample area shown on Figure 8, with the condition that visibly disturbed areas associated with other industrial operations will not be sampled. These samples will be collected from the 0 to 6 inch depth interval and will be analyzed for the specific analytes for which a background characterization is needed.

3.4.4 Residential Surface Soil Investigation Samples

As part of the residential surface soil investigation program described in the RI/FS Work Plan, samples will be collected from the 0 to 1 inch depth interval at 3 judgment-based locations in the Lot 21 sand blasting area, 7 judgment-based locations along the western boundary of Lot 21 at the Site where a dust screen was formerly located, and 27 random locations within a 100-foot sample block grid on off-site Lots 19 and 20 (Figure 9). In addition, samples shall also be collected from the 0 to 1 inch depth interval on the seven residential properties on the west side of Snapper Lane, subject to acquisition of appropriate access agreements. For these residential properties, a five-point composite sample will be collected from the front yard of the property, a five-point composite sample will be collected from the back yard, and a four-point composite sample will be collected from the drip zone near the mid-point of each side of the residence on the property (for those properties containing a residence) in accordance with guidance in the EPA Superfund Lead-Contaminated Residential Sites Handbook (EPA, 2003). Composite samples will also be collected from any distinct play areas and gardens present on the residential properties to be sampled.

The residential surface soil investigation program will be performed in several steps. After analytical data from surface soil samples from Lot 21 have been obtained, samples will be collected from Lots 19 and 20 with the analyte list for these samples developed based on the PSV comparisons for the Lots 21, 22 and 23 sample data described in the RI/FS Work Plan. Samples will then be collected from the residential properties on the west side of Snapper Lane with the analyte list for these samples developed based on PSV comparisons to the Lot 19 and 20 samples. If there are no PSV and background exceedences in a given step, then the subsequent step would not be performed. Additional residential properties will be sampled if data from any of the

residential properties on the west side of Snapper Lane exceed the PSVs and background and the exceedence is attributable to the Gulfco site.

3.4.5 Soil Fate and Transport Characterization Samples

In addition to the COI analyses described above, three representative soil samples from the North Area and three representative soil samples from the South Area (to be selected based on field observations) will be analyzed for bulk density, specific gravity, fraction organic carbon (foc), and pH to support evaluations of contaminant fate and transport. These samples will be collected from the 12-inch to 24-inch sample interval at a location where no visual evidence of contamination is observed.

3.5 WATER WELL SURVEY

The objective of this task is to provide supporting information for evaluating the potential for contaminant migration to water supply wells, as detailed in the RI/FS Work Plan. The following activities shall be performed during this phase of the investigation:

- An updated search of Texas Water Development Board (TWDB) and TCEQ records for all registered water wells located within ½-mile radius of the Site boundary will be performed.

- After the records search has been conducted, a field survey to confirm/update information obtained during the records search will be performed and attempts will be made to identify any unregistered water supply wells located within ½-mile radius of the Site boundary.

3.6 GROUNDWATER INVESTIGATION

The objective of the groundwater investigation is to evaluate the lateral and vertical extent of potential non-aqueous phase liquids (NAPLs) and COIs in groundwater as detailed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- Installation and development of 17 permanent groundwater monitoring wells in the vicinity of Site PSAs as shown on Figures 5 and 6 and listed below:

    a. Former AST Tank Farm Area – three monitoring wells around the containment area, with one well between this area and the adjacent barge slip (Figure 6);

b. Pipelines – one monitoring well along path of pipeline from former AST Tank Farm Area to former surface impoundments (Figure 5), and one monitoring well between the former AST Tank Farm and the Intracoastal Waterway (Figure 6);

c. Former Surface Impoundment Area – four monitoring wells on impoundment perimeter (Figure 5);

d. Former Wash Water Storage Tank Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

e. Sand Blast Areas – one monitoring well at each of the two sand blast areas, with one of the wells near the nearby barge slip (Figure 6);

f. Welding Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

g. Surface Drainage Areas – one monitoring well in the east surface drainage area, near the Intracoastal Waterway (Figure 6);

h. Former Septic Tank Areas – one monitoring well at each of the two former septic tank areas (Figure 6); and

i. Former Product Storage Tank Area – one monitoring well (Figure 5).

These PSA-based wells include four locations immediately northwest of the Intracoastal Waterway and two near the Site barge slips that will provide an indication of groundwater conditions near likely points of discharge to surface water.

- Temporary piezometers will be installed at two locations southwest of the former surface impoundment area (Figure 5), four locations on the former impoundment perimeter (Figure 5), one location southwest of the former Dry Dock (Figure 6), and one location south of the western former Septic Tank Area (Figure 6).

- Two staff gauges will be installed at the Site; one in the wetlands in the North Area (Figure 5) and a second gauge along the shore of the Intracoastal Waterway (Figure 6). The proposed locations for the staff gauges are subject to modification based on field conditions.

Monitoring well locations may be modified in the field based on accessibility constraints or field observations. Details of the monitoring well and temporary piezometer installation, development, water level measurements (including NAPL measurements), and groundwater sampling are presented in Section 5.5. Groundwater samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures detailed in Section 5.5.2. Groundwater samples will be analyzed for the suite of analyses listed in Table 2.

The monitoring well and staff gauge locations will be surveyed by a licensed surveyor to Texas State Plane Coordinates. Top of casing elevations and staff gauge measurement points will be surveyed relative to mean sea level (MSL). In order to evaluate groundwater flow rates and directions, Site water level data with the well and staff gauge survey data will be used to construct potentiometric surface maps for the Site. In addition, the staff gauge readings will be used to correlate the surface water elevations with the groundwater elevations.

3.6.1 Hydraulic Testing

Wells for hydraulic testing will be selected based on lithologic data, water level measurements, and drawdown/recharge behavior during development and sampling. The goal is to select wells that represent the range of hydraulic conditions in the water-bearing unit to be evaluated. Hydraulic testing and associated data analysis procedures are detailed in the Section 5.5.3.

3.6.2 NAPL Delineation

The objective of this task, if proven necessary from the initial groundwater investigation, will be to define the lateral extent of NAPL in the affected water-bearing unit. A combination of direct push methods, auger drilled soil borings, and/or monitoring wells may be used in this effort. The lateral extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well. Any NAPL field screening techniques used in this effort will be subject to Demonstration of Method Applicability (DMA), which will be submitted to the EPA for review and approval following the initial monitoring well installation.

If the presence of NAPL is identified in any of the monitoring wells installed, the following actions will be taken:

- Attempts will be made to collect a sample of the NAPL from each well in which it is observed. NAPL samples will be analyzed for specific gravity, VOCs, SVOCs and pesticides as presented on Table 2.
- The use of possible field screening methods to evaluate NAPL presence will be evaluated following the initial monitoring installation. If a promising candidate method is identified, a pilot test of the method will be performed, and depending on the pilot test results, a DMA will be prepared.

- The vertical extent of NAPL will be defined by advancing deeper borings (using direct push or auger methods) or installing deeper monitoring wells outside the perimeter of the identified NAPL zone to the base of the next underlying water-bearing unit, or within the NAPL zone if a surface isolation casing is used and a competent underlying confining unit is identified. The vertical extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well.

- Additional soil borings will be drilled to delineate the lateral extent of NAPL in the water-bearing zone(s).

3.6.3 Additional Groundwater Delineation

Should any groundwater sample locations at the perimeter of the Site exceed the PSVs, as detailed in the RI/FS Work Plan, then additional lateral groundwater delineation sampling will be conducted by using reconnaissance field methods (i.e., temporary piezometers). Additional vertical delineation will be conducted by collecting at least three groundwater samples from the next water-bearing zone below the affected water-bearing zone. These samples may be collected from permanent monitoring wells or temporary piezometers. It is likely that a surface or isolation casing may be installed prior to placement of the deeper well or piezometer. Hydraulic testing, as described in Section 3.6.1, will be performed for all affected water-bearing units.

3.6.4 Deep Lithologic Boring

In response to EPA requests, the subsurface stratigraphy from the ground surface to the top of the uppermost water supply aquifer will be evaluated through advancement of a mud-rotary pilot boring to an approximate depth of 200 feet. The location will be selected following delineation of the lateral extent of COIs exceeding PSVs to ensure the boring is not drilled in an area where Site contaminants might migrate to deeper water-bearing units. The pilot boring will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the drill cuttings to correlate the lithology to the geophysical signatures. Details of the pilot hole drilling, geophysical logging, and abandonment procedures are provided in Section 5.6.

3.7 SURFACE WATER INVESTIGATION

The objective of this task is to evaluate the lateral extent of potential COIs in surface water to evaluate potential human health and ecological risks listed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- On-Site Pond Sampling: The following surface water samples will be collected from each of the two ponds north of Marlin Avenue (Figure 5):
    - Three surface water samples will be collected from the Fresh Water Pond; and
    - Three samples will be collected from the Small Pond southeast of the Fresh Water Pond.

  The surface water samples will correspond with the pond sediment sampling locations discussed in Section 3.8 below.

- Intracoastal Waterway (ICWW) Sampling: One composite surface water sample will be collected from each of the four zones within the ICWW adjacent to the site as shown on Figure 10. Each composite will consist of three sub-samples. One sub-sample will be collected from approximately one foot below the water surface, the second sub-sample will be collected from mid-depth of the water column, and the third sub-sample will be collected from approximately one foot above the base of the water column.

- Wetlands Area Sampling: Surface water samples will be collected from 15 locations within the wetlands north of Marlin Avenue (including both on-site and off-site locations). The area that will be sampled is shown on Figure 11. These sample locations will be selected in the field based on drainage features and field observations.

- Background Sampling: Four composite background surface water samples will be collected from the background surface water sampling area shown on Figure 12. These composite samples will be collected in the same manner as the ICWW samples.

The surface water samples will be tested for the suite of analyses as presented on Table 2. Filtered and unfiltered samples will be collected for metals analyses. Sample collection procedures are specified in Section 5.7.

3.8 SEDIMENT INVESTIGATION

The objective of this investigation is to evaluate the lateral extent of COIs in sediments to evaluate potential human health and ecological risks listed as detailed in the RI/FS Work Plan. Sediment samples will be collected from the 0 to 6-inch depth interval at all locations. Deeper sediment samples will be collected from the 12 to 24-inch depth interval at any locations in the North Area where, based on field observations, dry conditions at this depth are indicated. Sediment samples will be analyzed for the analytical suites listed on Table 2.

The following areas will be sampled during this phase of the investigation:

- Fourteen sediment samples will be collected using the random systematic method on a 200-ft grid within the wetland areas in the North Area. Proposed locations are presented on Figure 5; however, locations may be modified based on field observations.
- Five sediment samples will be collected within the Fresh Water Pond on Lot 55 of the Site (Figure 5).
- Three sediment samples will be collected from the small pond to the southeast of the Fresh Water Pond, (Figure 5).
- Sediment samples will be collected from 15 off-site locations within the wetlands north and east of the Site. The general area from where samples will be collected is shown on Figure 11. These sample locations will be selected at the time of sampling based on drainage features and field observations.
- Sediment samples will be collected from the Barge Slips and Intracoastal Waterway as shown on Figure 10 and detailed below:
    - Barge Slip 1 (western barge slip) – five locations;
    - Barge Slip 2 (eastern barge slip) – five locations;
    - Intracoastal Waterway – six locations; and
    - Background – nine locations (background area shown on Figure 12).

Sediment samples will be collected using the procedures outlined in Section 5.8.

3.9 FISH TISSUE SAMPLING

Using the sediment data collected from the Intracoastal Waterway, the COIs for the fish tissue sampling will be established as detailed in the RI/FS Work Plan. The tissue from the following target fish (*species*) will be analyzed:

- red drum (*Sciaenops ocellatus*),
- spotted seatrout (*Cynoscion nebulosus*),
- southern flounder (*Paralichthys lethostigma*), and
- blue crabs (*Callinectes sapidus*).

If a sufficient number of specimens of the target species can not be collected at the Site during the sampling event, the following fish will serve as alternate species:

- Atlantic croaker (*Micropogonias undulates*);
- sheepshead (*Archosargus probatocephalus*), and/or
- black drum (*Pogonias cromis*)

No alternate shellfish species is proposed.

Finfish specimens will be collected using a combination of gill nets and baited hooks. Two sizes of gill net mesh will probably be used during the study (5 and 2 ¾ inch stretch mesh). Gill nets will be set at stations within four zones, as shown in Figure 10. Multiple nets and traps will be set in each sampling zone to ensure that a sufficient number of specimens of each species are collected in a short period of time. If composite samples are necessary, only tissue collected within a single zone will be composited. A total of 9 samples from each of the four target species (a total of 36 samples) will be collected and processed for analysis. One field duplicate will be processed for each species.

Background finfish/crab samples will also be collected at the area shown on Figure 12. Nine samples from each of the four species will be collected and sent to the laboratory. Laboratory analysis of the background samples will be conducted pending the results of the Site samples. The numbers of samples that are expected to be collected and analyzed are listed in Table 3. Fish tissue sampling procedures are presented in Section 5.9.

Since the objective of this study is to evaluate edible tissues, only fish and crabs that can be legally harvested by recreational or commercial fishermen will be collected. The size limits for each species will be based on Texas Parks and Wildlife size limits for recreational fishermen. Size limits for this study are listed in Table 3.

4.0 SAMPLE DESIGNATION

The station and sample numbering system for the project has been designed to uniquely identify each sampling station and sample according to the Site grid. This numbering system consists of grid column and row identification, sample media, a sequential sample location identifier, depth (if applicable), and QA/QC identifier (if applicable).

Two grid systems have been designed for the Site: a 200-foot grid for the North Area and a 100-foot grid for the South Area. The North Area grids will be assigned an "N" prefix and the South Area grids will be assigned an "S" prefix. Each column of each grid system will be assigned a letter (A, B, C…) and each row will be assigned a number (1, 2, 3…) as shown on Figures 5 and 6. Sediment and fish tissue samples collected from the Intracoastal Waterway will have an "IW" prefix and no grid designation.

Sample locations will be designated by sample type:

- soil boring (SB),
- monitoring well groundwater (MW),
- temporary piezometers (PZ),
- sediment (SE),
- surface water (SW)
- geotechnical (GT)
- surface soil (SS) or
- fish tissue and species (RD-red drum, ST-spotted seatrout, SF-southern flounder, BC-blue crab) (e.g., FTRD).

Following the sample type will be the sample location numbers. Generally, the samples for each media will be sequentially numbered, regardless if the sample station is a random or judgmental location. Depth intervals in feet below grade will be assigned to soil and sediment samples to designate the vertical sample location. As an example, the first sediment sample collected from 0 to 6 inches deep at a sample station north of Marlin Avenue at grid A1 for chemical analysis will be designated as follows:

- Sample ID: NA1SE-001-(0-6)

Field quality control samples such as matrix spikes and matrix spike duplicates and field duplicates, which are detailed in the QAPP, will be designated with the primary sample identification and a quality control suffix as noted below. Quality control samples for geotechnical analyses will not be collected.

Quality Control	Suffix Description	Sample Frequency
MS/MSD	Matrix spike/duplicate	1 per 20 samples per media
FD	Field duplicate	1 per 20 samples per media
EB	Equipment rinsate blank	1 per day/team
FB	Field blank	1 per day/team

5.0 SAMPLING EQUIPMENT AND PROCEDURES

5.1 FIELD EQUIPMENT

Various equipment will be used during the RI/FS field investigation. A partial list of possible equipment that will be used during the RI/FS are listed by investigation activity on Table 4. Additional equipment may be used as part of the RI depending if additional investigative techniques are necessary to achieve the project objectives.

At a minimum, field equipment will be cleaned, inspected, calibrated (if required), and tested prior to each day's use, or every month, whichever comes first. Equipment calibration guidelines are discussed in the QAPP, Section 3.8 (SAP Volume II). All equipment will be inspected visually and functionally by testing the equipment in accordance with the operator manual for each piece of equipment. Moving parts, seals, fasteners, and switches will be inspected and adjusted or replaced as necessary. All cables, tapes, and attachments will be inspected for damage or kinks. For equipment that requires standard solutions and buffers for calibration, those standards and buffers will be checked for expiration date and replaced if necessary. Preventative maintenance for the field equipment is discussed in the QAPP, Section 3.7 (SAP Volume II). The Field Supervisor is responsible for the proper functioning of field equipment.

5.2 LOCATING SAMPLING SITES

The proposed sample locations will be located in the field using the coordinates extrapolated from proposed sample locations on the Site maps. A differential GPS receiver, such as a Trimble GPS Pathfinder Pro XRS or equivalent, will be used to locate the proposed sampling sites in the field. Operation of the GPS receiver will follow the procedures detailed in the operation manual for the specific equipment.

Once a sample station is located according to the GPS coordinates, the station will be marked with a stake and brightly colored survey flagging material. If a sampling site is not accessible, an alternate location will be selected as near to the original point as practical. The alternate location will be marked with a stake, flagged, and the coordinates recorded. A utility locating service such as Texas One Call or Dig Tess will be contacted to check the proposed locations for the presence of buried utilities.

All sample stations will be marked in advance of sampling to minimize the collection of surface waters and sediments at sites where the area has been disturbed due to foot traffic. Navigation to a specific site will disturb the sediments in wetland areas, resulting in turbid surface water samples at those locations. Premarking the sample stations will aid in reducing this disturbance.

5.3 SURFACE GEOPHYSICAL SURVEY

As discussed in Section 3.3, a surface geophysics assessment using EM meters will be conducted to attempt to locate former pipelines at the Site. The assessment will be conducted with a Geonics EM-61 MK2 metal detector and an EM radiodetection (RD) meter.

The EM-61 MK2 is a time-domain metal detector which detects both ferrous and non-ferrous metals. A transmitter generates a pulsed primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil. By taking the measurement at a relatively long time after the start of the decay, the current induced in the ground has fully dissipated and only the current in the metal is still producing a secondary field. The responses are recorded and displayed by an integrated data logger (Geonics, 2005).

The RD meter, which operates similarly to the EM-61 MK2, detects the magnetic field created by alternating current flowing along a buried line. This alternating current creates a detectable magnetic field or signal because the current provides a magnetic field and an oscillating frequency of reversals. With both of these occurring, the pipe or line can be effectively located using the principles of electromagnetic induction. The RD meter can be operated in two modes: passive and active. The passive mode detects signals that are 'naturally' present. These signals can be produced by induction of electrical currents flowing from stray currents produced by power transmission systems and/or very low frequency long wave radio energy from distant transmitters. Active mode detection consists of applying an active signal directly to a line or by induction from a transmitter where the line can then be traced and located by the receiver (Radiodetection, 1994).

Both meters will be used in the field to identify and locate buried pipelines. The meters will be operated according to the operations manual for each meter.

5.4 SOIL INVESTIGATION METHODS

5.4.1 Soil Sampling

Shallow soil samples (0 to 2 feet bgs) may be collected using either plastic or stainless steel trowels, hand-auger, or by a split-spoon sampler driven by direct-push technology (DPT) techniques or a drill rig. Soil borings drilled with DPT will be advanced using a hydraulic ram or hammer to drive the soil samplers, and the soil samples may be collected using a butyrate-lined, split-spoon sampler. Soil borings that will be converted to monitoring wells may be drilled with hollow-stem auger methods and the borings for the temporary piezometers will be drilled using DPT methods. All sampling equipment will be decontaminated prior to and following each use, as detailed in Section 5.10.

Soil borings will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of each boring and soil samples will be collected. The method of sample collection and the sample collection interval will also be noted on the field lithologic log.

Soil samples collected at each location will be collected in accordance with the PBW SOP No. 5: Soil and Sediment Sampling for Chemical Analysis (Appendix A). For soil samples that will be analyzed for VOCs, samples will be collected using the SW-846 5035 Method by utilizing the EnCore® or equivalent sampling equipment. The 5035 Method procedures are detailed in PBW SOP No. 5. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks as described in the QAPP Plan (Volume II).

For borings not converted to a monitoring well or a piezometer, the boring will be abandoned by filling the hole. If the boring is less than 2 feet deep, it can be filled with bentonite pellets. If the borehole is dry and is less than 10-feet deep, Portland/bentonite grout may be poured slowly from the ground surface into the borehole to the ground surface. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. Specific procedures on plugging of borings are provided in PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A).

5.4.2 Field Screening

Soil samples from the monitoring wells and temporary piezometers will be collected and screened in the field for total organic vapor concentrations using an organic vapor meter (OVM)/photoionization detector (PID). Field screening will be conducted following the procedures detailed in the PBW SOP No. 3: Field Organic Vapor Screening Methodology for Soil Samples (Appendix A) and documented on the field lithologic log.

5.4.3 Impoundment Cap Sampling

Geotechnical soil samples may be obtained from the core using hollow-stem auger drill rig, direct push techniques (DPT), or from hand sampling devices. Soil samples to be analyzed for geotechnical analyses will be stored in sealed tubes or wrapped in aluminum foil and cellophane. Samples for moisture content must be sealed to preserve its natural moisture content. Undisturbed samples will be obtained with a thin-walled Shelby tube sampler and will be protected during shipping/transport. If materials are too consolidated and cannot be sampled with the Shelby tube, split spoon samples may be obtained and the sample will be wrapped in aluminum foil and plastic.

5.5 GROUNDWATER INVESTIGATION METHODS

The groundwater investigation will consist of installing and sampling groundwater from both permanent monitoring wells and temporary piezometers and conducting hydraulic testing on the uppermost water-bearing units at the Site. The equipment and procedures for these activities are discussed below.

5.5.1 Permanent and Temporary Well Installation

5.5.1.1 Permanent Monitoring Well Installation

Soil borings for monitoring wells will be advanced using hollow stem auger drilling methods. Soil samples will be collected continuously from each boring and will be logged in the field for lithology and sedimentary structure as described in Section 5.4. Soil headspace samples will be collected every two feet and screened in the field for total organic vapor concentrations. In addition, soil core samples will be visually inspected for NAPL presence. Soil cuttings generated

from the drilling activities will be stored and disposed of following the procedures detailed in Section 7.0.

Soil borings that will be used for monitoring well installation will be advanced as necessary to identify the top and base of the uppermost water bearing-unit at the Site. Based on the boring logs for previous monitoring wells drilled at the Site, it is anticipated that these borings will be advanced to a maximum depth of 30 feet. If necessary, deeper borings will be advanced to underlying water-bearing units. Although these borings will be located away from areas where NAPL is present (if any), surface or isolation casing may be installed prior to penetration of any low permeability confining unit. In no case will a boring in which field indications of a NAPL are noted be advanced through an underlying low permeability confining unit.

Permanent monitoring wells will be constructed after the total depth of the borehole is reached. Monitoring wells will be constructed using 2-inch diameter, flush-joint-threaded Schedule 40 PVC casing and 0.010-inch slotted PVC screen. The specific well design will be determined in the field based on the observed lithology with the goal of screening the well at the base of the uppermost water-bearing unit. It is anticipated that each well screen will be approximately 10 to 15 feet in length and where possible will extend above the observed groundwater table. After the boring is completed to the total depth, the casing and screen will be lowered into the borehole through the augers.

Once the casing and screen are in place, the remaining well materials (filter sand, bentonite pellets, and cement/bentonite grout) will be added to the hole as the augers are slowly removed. Depths to the top of the annular materials will be measured with a weighted, calibrated tape and recorded on the Well Completion Log (Appendix A, Figure SOP-7-1). A bentonite seal layer will be installed on top of the filter sand and will be a minimum of 2 feet in thickness. The remainder of the borehole annulus will be filled with a Portland/bentonite grout (or bentonite pellets). Each well will be completed with either an at-grade surface completion with a 3-foot by 3-foot pad or above grade within a protective casing on a 4-foot-by-4-foot concrete pad. After construction, the position and elevation of each monitoring well will be surveyed relative to Texas State Plane Coordinates and mean sea level. Procedures for monitoring well installations are outlined in PBW SOP No. 7: Installation of Monitoring Wells and Piezometers (Appendix A).

A minimum of 24 hours shall elapse after well construction and before well development to allow for bentonite hydration and grout set. Development will consist initially of surging and bailing or pumping; however, the specific development method will ultimately be decided by the field personnel based on the specific conditions encountered. Temperature, pH, specific conductivity, and turbidity will be monitored during purging. Development will continue until the well produces water with stable field parameter readings (i.e., temperature, pH, conductivity) and turbidity is below 10 NTU. At least five casing volumes of water will be removed from the well during development. If the turbidity is not below 10 NTU after 10 casing volumes of water are removed from the well, then the final turbidity will be recorded and more aggressive development procedures such as air lifting may be considered. General procedures for monitoring well development are outlined in PBW SOP No. 8: Monitoring Well Development (Appendix A).

Documentation of well installation and development will include field boring logs, monitoring well installation forms, well development forms, and any photographs, as described in PBW SOP No. 1 Field Documentation (Appendix A).

5.5.1.2 Temporary Piezometer Installation

Temporary piezometers will be installed at selected locations as discussed in Section 3.6. Temporary piezometers may be installed using DPT methods, or similar methods. If the temporary piezometers are to be installed with DPT, the initial soil boring drilled to describe the lithology and soil field screening will be plugged and the temporary piezometer will be installed in a second boring no closer than 3 feet from the original soil boring to the target depth.

The piezometers may be constructed of small diameter (0.5 to 1-inch), flush-joint-threaded Schedule 40 PVC with a prepacked screen assembly and riser casing. A temporary surface seal will be placed in the borehole annulus to prevent surface water from traveling into the borehole after piezometer installation.

Each temporary piezometer will be developed, and purged and sampled relatively soon after installation. Development of the temporary piezometers will consist of pumping the piezometers at less than 1 liter per minute until the turbidity is less than 10 NTUs. If after 10 casing volumes are removed and the turbidity is still greater than 10 NTUs or if the temporary piezometers pumps

dry, the Field Supervisor will decide if additional development is necessary depending on the field conditions and professional judgment.

The height of the PVC casing above the ground surface will be measured. Within 48 hours of installation, the temporary piezometer will be plugged and abandoned using the procedures detailed in PBW SOP No. 2 – Supervision of Exploratory Borings (Appendix A).

5.5.2 Groundwater Sampling

General procedures for groundwater sampling are outlined in PBW SOP No. 10: Water Quality Sampling (Appendix A). Groundwater samples will be collected from each of the monitoring wells no sooner than 24 hours after the completion of well development. Sampling of the temporary piezometers can be conducted shortly after installation and development. Before sampling, a complete set of water levels (including an evaluation of the possible presence of NAPL using an interface probe, conductivity probe and/or bailer) will be measured in all wells. In the event that NAPL is observed, an attempt will be made to collect a NAPL sample for possible future analysis.

Groundwater wells and piezometers will be purged and samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures. Purging will be accomplished in such a way as to minimize disturbance of sediments at the bottom of the well, and therefore minimize turbidity of the water samples. Typically, this is accomplished by purging at a low flow rate (less than one liter per minute) with the pump intake near the middle of the screened interval. If the yield of the well is low such that it can be pumped dry, then the recharged groundwater in the well will be considered representative of the formation groundwater, since all standing water in the well has been replaced by recharge from the water-yielding zone. Investigative-derived waste (IDW) (decontamination and purge water) will be placed and stored in drums at a designated staging area for off-site disposal, as detailed in Section 7.0.

Purging of the wells and piezometers will be accomplished by purging at a rate between 0.1 and 1 liters per minute while monitoring the following field parameters every 5 to 10 minutes: specific conductance, pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Procedures for taking ORP and DO measurements are detailed in PBW SOP No. 11:

Field Measurement of Oxidation-Reduction Potential (ORP) and PBW SOP No. 12: Field Measurement of Dissolved Oxygen (DO) (Appendix A). Meters will be calibrated before sampling each day, using the manufacturer's procedure. Odor and color of the purge water will also be noted. The field measurements will be recorded on the groundwater sampling record (Appendix A, Figure SOP-10-1).

Each monitoring well and piezometer will be purged until a minimum of five readings for the following parameters have been recorded and three consecutive readings have stabilized to within the following limits:

- specific conductance: +/- 10 percent
- pH: +/- 0.1 units
- temperature: +/- 1 degree Celsius
- turbidity: +/- 10 percent (or less than 10 NTUs)

After purging, groundwater samples will be collected from the discharge of the pump. If the stabilized turbidity reading is greater than 10 NTU, the discharge from the pump will be filtered with an in-line 10 µm filter. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled. Filters and tubing will be used for only one sample and subsequently disposed.

Sample bottles will be prepared specifically for the required analyses by the analytical laboratory. Any required preservatives will be placed in the sample bottles by the laboratory prior to shipment to the Site. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks, and samples will be handled, packaged, and transported as described in the QAPP (RI/FS SAP, Volume II (PBW, 2006b)).

Documentation will include groundwater sampling forms and any associated photographs.

5.5.3 Hydraulic/Slug Testing

Falling-head or rising-head tests ("slug tests") will be performed in the monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Slug tests will consist of instantaneously raising or lowering the water level in a well and then monitoring the change of the water level through time. The slug tests will be performed by rapidly submerging (slug-in test) or retracting (slug-out test) a slug of known volume. A typical slug used in two-inch wells is constructed of a sealed, one-inch diameter, PVC or stainless-steel pipe filled with sand. The displacement volume of the slug will be measured prior to the test program.

A pressure transducer or electric water line with an appropriate operating range may be used to measure the water levels during the slug tests. The pressure readings will be recorded and converted to feet of water above the transducer using a datalogger. The datalogger is programmed to record the water levels at one-second intervals at the beginning of a test and logarithmically increased to several minutes toward the end of the test. Upon arrival at each test well site, the static water level and total depth of the well will be measured with an electric water level interface probe. In the event NAPLs are encountered in the well, the hydraulic testing may be terminated. The pressure transducer will then be secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time will be allowed for the water level in the well to adjust to the displacement caused by the transducer and cable, and for the transducer to equilibrate to the water temperature. During this period, the water level in the well will be monitored electronically using the datalogger and measured periodically with the electric water level probe to confirm that static water level conditions exist. Next, the slug will be lowered to a point just above the water level in the well and then rapidly submerged to begin the test. As data are collected, the water levels displayed by the datalogger will be examined to monitor trends and the progress of the test. Manual water level measurements also may be taken during the test to confirm the transducer readings.

Each test will proceed until the water level attains at least 90 percent recovery from the falling head test and rising head test. Following completion of the slug-in test, a rising-head or slug-out test will be performed by rapidly pulling the slug out of the water and monitoring the water level recovery in the same manner as for the slug-in test. In some cases, more than one slug-in and/or slug-out test may be performed to provide additional confirmation of the results.

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a computer in the field. When transferred to computer, the data sets are generally saved as comma-delineated ASCII format files. The contents of each data file are imported to a spreadsheet program that allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone. Slug test data will be analyzed by the methods discussed in PBW SOP No. 15: Hydraulic Testing (Appendix A).

5.6 DEEP BORING INSTALLATION AND GEOPHYSICAL LOGGING

Geophysical logging will be performed at one location in order to evaluate the subsurface lithology to the uppermost drinking water zone, estimated to be 200 feet below grade. The borehole will be drilled using wet-rotary drilling techniques and the drill cuttings will be described during the drilling operations. The soil boring will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Appendix A, Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of the boring. The lithologic description of the log should include soil or rock type, color, grain size, and other pertinent information, which will be noted on the field lithologic log.

After the borehole has been drilled to the desired depth, the borehole will remain filled with the drilling fluid to provide a conductive medium for running the geophysical logging tools. The test hole will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the boring log (or cuttings) to correlate the lithology to the geophysical signatures. After the borehole has been logged, the hole will be plugged by placing one continuous pour by pumping through a tremie hose or pipe. Specific procedures on plugging of borings are provided in PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A).

5.7 SURFACE WATER SAMPLING

When both sediment and surface water paired samples will be collected, the surface water samples will be collected prior to sampling of submerged sediments in order to reduce disturbance of the surface waters prior to their collection for chemical analyses. It is preferred that surface water samples be collected without entering the water or from a distance to minimize disturbance of sediments at the location where the surface water is to be collected. Within the wetland and pond areas, a single surface water sample is proposed for collection at each site (not including QA/QC samples collected at the frequency indicated in the QAPP). Composite depth samples will be collected from the ICWW locations as described in Section 3.7. Water depth will be recorded, and water chemistry parameters will be collected at all sample locations. These parameters will be collected using a multi-probe sonde that directly measures ambient:

- pH,
- conductivity,
- temperature,
- oxidation-reduction potential,
- salinity, and
- dissolved oxygen.

Surface water samples will be collected from the wetland and pond areas using either a dipping bucket on an extended pole or using a pole with attached peristaltic pump tubing to pump samples directly to the sample containers. The sample will be collected from the top quarter of the water column. Once sufficient water volume has been collected for each sample station, the sample will be placed into the respective sample containers for the analyses to be conducted. Surface water samples analyzed for metals will be collected in two samples: filtered and unfiltered. PBW SOP No. 10: Water Quality Sampling (Appendix A) provides details for the specific protocols for sampling of surface waters, including filtering procedures. The surface water sample stations will be surveyed using the differential GPS receiver, as detailed in Section 5.11.

Surface water sample stations within the ICWW will be located using a sub-meter Global Positioning System (GPS) and site coordinates will be recorded. Sampling will be performed using a custom 20 ft. aluminum flat bottom boat as the sample platform. Wherever possible, the

sample platform will be positioned on station by tying off to shoreline structures to avoid using anchors that could disturb the sediment at the sample site. If anchors are required to stabilize the sample platform, anchors will not be positioned up current of the sampling point.

At each station, physical and chemical parameters, and analytical water samples will be collected from three depth strata (1 foot below the water surface, mid-depth, and one foot above the surface of the sediment). Water samples will be collected using a variable speed peristaltic pump fitted with pre-cleaned sample tubing. Physical and chemical parameters will be measured using portable field grade instruments (YSI 63, YSI 55, and HF Scientific Micro TPW). The tip of the sample tubing and instrument probes will be attached to a weighted cable and lowered to sampling depths from the boat. Data and samples will be collected during a slack tide.

At each station, the sample tubing and instrument probes (attached 1 foot above the weight) will be slowly lowered until the weight touches the surface of the sediment. Water depth, turbidity, dissolved oxygen, pH, salinity, conductivity, and water temperature will be measured and recorded. A peristaltic pump will be engaged and the water collection apparatus will be purged for two (2) minutes. The sample collection apparatus will consist of pre-cleaned Teflon and C-flex tubing attached to a 5 micron (pre-filter) and a 0.45 micron final filter. Following the system purge, a filtered water sub-sample (1/3 total volume) will be collected directly into a sample container. This process will be repeated at the two remaining sample depths to complete the filtered water sample.

The water filters will be removed from the sample tubing and an unfiltered water sub-sample (1/3 total volume) will be collected at each sample depth. A sample of unfiltered water will also be collected at each depth for total suspended solids (TSS). A clean sample collection apparatus will be used at each station.

5.8 SEDIMENT SAMPLING

Sediment sample stations will be selected in advance of the study based on investigation requirements. The objective of the station selection process will be to distribute sample stations evenly over the project area and to adequately represent all bottom types. The area includes high energy unvegetated shoreline (with and without bulkhead), and low energy sediment sumps

(inside barge slips). A sample station map will be developed and the sample station coordinates will be determined before sampling is initiated.

Sampling will be conducted from a custom 20-foot aluminum boat. Sampling in the shallow Fresh Water Pond and smaller pond in the North Area will be conducted from a 14-foot aluminum skiff. Sampling in the intertidal marsh will be conducted by wading to the sample stations. A differential GPS receiver with sub-meter accuracy will be used to locate the stations and record actual coordinates, as detailed in Section 5.11. Sample station information, sample depth, and all other pertinent observations made during the study will be recorded on field data sheets.

Marsh Sediment

Sediment will be collected from the intertidal marsh by approaching the sample site on foot, being careful not to impact the area to be sampled. The sample will be collected using a stainless steel scoop or spoon, and will be placed in a stainless steel bowl for homogenization except for samples for VOC analyses, which will not be homogenized. Aliquots of the sample will be removed from the bowl and placed in pre-cleaned labeled sample jars. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

Grab Sampler

Soft surficial sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond will be collected using an Ekman grab (or equivalent). The jaws of the sampler will be locked open and the sampler will be lowered to the bottom on a cable or attached to a stainless steel pole. To prevent forward wake, the sampler will not be lowered faster than 0.3 m/sec as it nears the bottom. The sampler will be retrieved slowly to ensure proper jaw closure. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment movement.

A sediment sample will be acceptable if its depth is greater than 6 inches and the surface is relatively flat and undisturbed. If a sample is not acceptable it will be set aside (do not dump overboard), and a second sample will be collected. Unacceptable samples will be discharged overboard after an acceptable sample is collected.

Prior to removing sediments from the sampler, overlying water will be drained by gently tilting it. A 0 to 6-inch sub-sample will be collected from the top of the closed sampler using a pre-cleaned spoon, scoop, or core tube. Sediment will be removed using pre-cleaned spoons and composited in pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

Core Sampler

Samples of stiff sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond may be collected using a piston-coring device if the grab sampler is not effective at collecting a representative sample. The coring device consists of a 3-inch diameter polycarbonate core tube attached to the end of an aluminum pole. The coring device will be manually driven into the sediment until firm resistance is detected. In the event that a single core does not provide the volume of material required by the analytical laboratory (approximately 1 liter), additional cores will be collected at that station to provide the required sediment. All cores samples from the same station will be combined and homogenized before aliquots are removed.

Sediment from 0-6 inches will be extruded into a stainless steel bowl and a sub-sample will be immediately removed with stainless steel spoon for volatile organic analysis. The remainder of the sample will then be homogenized and placed in containers for other analyses.

The empty sampler (Ekman or core) will be rinsed and decontaminated following the procedures presented in Section 5.10. The sampler and associated equipment will be decontaminated before use, and between sample sites. In addition, the sampler will be rinsed with Site water before samples are collected.

5.9 BIOLOGICAL SAMPLING

5.9.1 Fish Samples

To optimize fish capture rates, gill net placement will be timed to coincide with periods of highest fish activity (i.e., dusk to dawn). Nets will be set in the study area and background area in the late afternoon and fished through the night. To ensure that fish are removed from the nets as soon

after capture as possible, the collection devices will be checked and fish will be removed once every eight hours. Fish will be removed more frequently if water temperature exceeds 28°C. As soon as individual fish specimens are removed from the collection device, they will be rinsed in ambient water to remove any foreign material. Individual specimens of the target species will be grouped by species and general-size class and placed in clean holding pans onboard the boat to prevent potential contamination. Only legal size fish will be retained for analysis.

Fish collected for this project will be examined for morphological abnormalities. The examination will consist of an assessment of four gross morphological conditions associated with pathological disorders. The characteristics that will be evaluated are:

- Fin erosion;
- Skin ulcers;
- Skeletal anomalies; and
- Neoplasms (i.e., tumors).

Although gross morphological observations generally are not definitive indicators of fish health, they may be very useful in detecting pathological conditions in fishes. The examinations will be conducted as the specimens are sorted from the catch. Sampling crew members will be trained by a qualified fish biologist to identify the various kinds of pathological conditions that may be encountered. At least two pathological conditions (fin erosion and skin ulcers) can easily be confused with the external damage that fishes may suffer after they are caught in a gill net. For all suspected abnormalities that cannot be confirmed in the field, representative specimens will be archived for later evaluation by a qualified specialist.

Specimens selected for this study will be weighed and measured, and assigned a sample number. A sample number tag will be attached to the lower jaw of each fish. After labeling, all of the fish from a sample zone will be placed together in a watertight plastic bag and sealed. The bags will be placed in an insulated cooler with ice for temporary storage and transport to the sample processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type
- Water depth
- Set date
- Set time
- End date
- End time
- Field personnel
- Station ID
- Photo log

Additional procedures for collecting fish samples are provided in SOP-BESI-303: Collection of Finfish and Crabs Using Gill Nets (Appendix A).

5.9.2 Blue Crab Samples

Adult blue crabs (*Callinectes sapidus*) will be collected in baited commercial type crab traps (i.e., vinyl covered wire mesh). Bait will be commercial crab bait (i.e., frozen menhaden). Blue crabs captured in gill nets may also be used as samples. Traps will be placed at the selected sample sites and allowed to fish continuously until a sufficient number of crabs have been collected. Only tissue from crabs collected within a single zone will be composited. The number of crabs required to provide a minimum sample volume will depend on crab size and analytical requirements.

Immediately following collection, blue crabs will be rinsed in ambient water to remove any foreign material and inspected to ensure that their exoskeletons have not been cracked or damaged during collection. Damaged specimens will be discarded. After being rinsed, blue crab specimens will be grouped by general-size class and placed in clean holding tubs to prevent contamination.

Specimens selected for this study will be weighed and measured and assigned a sample number. Only crabs that can be legally harvested (i.e., $\geq$ 5 inch carapace width) will be used for this study. Both male and female blue crabs will be collected and combined for analysis. Female crabs can

be legally harvested unless they are gravid. If gravid female crabs are collected during this study, they will be released and not included in the samples. All specimens collected from a zone will be sealed in a watertight plastic bag with a sample number tag, and placed in an insulated cooler with ice for transport to the processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type
- Water depth
- Set date
- Set time
- End date
- End time
- Field personnel
- Station ID
- Photo log

Additional procedures for collecting crab samples are provided in SOP-BESI-304: Collection of Blue Crabs Using Commercial Crab Traps (Appendix A).

5.9.3 Sample Collection Requirements

The following procedures will be observed when passive collection devices (i.e., gill nets crab traps) are deployed:

- Target finfish will be removed from the passive-collection device (i.e., nets) at frequent intervals (less than 8 hours) during sample collection periods.
- Crabs captured in crab traps must be removed from the traps at an interval not to exceed 24 hours.
- All target species captured using passive collection devices will be alive at the time of removal from the sampling equipment. If they are not alive, they will be discarded.

All fish and crabs collected will be identified, counted, and logged into the field logbook. To be consistent with the convention used by most fisheries biologists in the United States, the total length of fish and carapace width of crabs selected for inclusion in the study will be measured in millimeters (*Measuring Fish Length and Wet Weight* (SOP-BESI-508) and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

Total length of a fish is defined as the length from the anterior-most part of the nose of fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorso-ventrally). Since the caudal fin of finfish is often damaged during capture, standard length will also be measured. Standard length of a fish is defined as the length from the anterior-most part of the nose of fish to the end of the caudal peduncle (caudal tip of the spine). Carapace width of a crab is defined as the distance from the tip of lateral carapace spine to the tip of the opposite spine.

The weight in grams of finfish and crabs selected for inclusion in the study will be measured immediately after capture. Fish and crab weights will be obtained according to the appropriate SOP (*Measuring Fish Length and Wet Weight* (SOP-BESI-508), and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

A Chain of Custody document will be initiated for the samples, and the appropriate information will be recorded on both the field-log sheet and chain document, as detailed in Section 6.1.2.

Because the objective of the study is to determine the concentration of selected analytes in the edible tissues of specific fish and shellfish species, correct identification is essential. Species identification will be conducted by experienced personnel knowledgeable of the taxonomy of aquatic species in the Project area. Taxonomic keys, appropriate for the central Texas gulf coast, will be onboard the sample vessel and will be consulted if necessary.

5.9.4 Tissue Processing

Fish and crab samples will be processed within 24 hours of collection. Samples will be processed on-site to reduce the amount of time between fish and crab collection, and tissue removal. Removal of edible tissue will follow the procedures described in the SOPs *Fish Tissue Processing* (SOP-BESI-509), and *Crab Tissue Processing* (SOP-BESI-507) (Appendix A).

5.9.4.1 Finfish Tissue

Finfish will be weighed, measured, scaled, and rinsed with DI water. Data will be recorded on tissue processing data sheets. Once a fish has been scaled it will be placed in clean plastic bags and stored on ice until all samples have been scaled. Edible tissue filets (with skin) will be processed on pre-cleaned Teflon cutting boards with pre-cleaned stainless steel filet knives. EPA Guidance (EPA, 2000) recommends that the fillets of scaled finfish (e.g., red drum, black drum, croaker, seatrout, etc.) be analyzed with the skin intact. Edible filets will be collected from both sides of the fish, placed on hexane-rinsed aluminum foil, and weighed in grams. The filets will be double wrapped in hexane-rinsed aluminum foil.

Most fish samples will be taken from a single specimen, but if a single fish can not provide the required sample volume, the fillets from multiple fish will be composited. If more than one organism is to be composited to complete a sample, the individual organisms will be filleted, filets will be weighed, and the filets will be combined and double wrapped in hexane-rinsed aluminum foil.

Foil wrapped filet samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station ID. The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed following the procedures detailed in Section 6.1.2.

5.9.4.2 Blue Crab Tissue

Blue crabs will be weighed, measured, rinsed with DI water, and placed on pre-cleaned Teflon cutting boards. Data will be recorded on tissue processing data sheets. Edible blue crab tissue (i.e., muscles inside chelipeds and musculature for periopods) will be removed using pre-cleaned scalpels and placed on hexane rinsed aluminum foil for weighing.

In order to provide the analytical laboratory with a sufficient quantity of tissue for all analyses, the edible tissue from five adult blue crabs from the same zone will be composited for each sample. The weight of edible tissue will be recorded for each individual crab and for the total edible tissue per sample. A pre-cleaned sample jar will be labeled with the collection date, time, personnel, species, and station ID.

Sealed samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station ID. The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed for all samples collected.

5.10 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination in accordance with PBW SOP No.13: Equipment Decontamination (Appendix A) will be performed for all equipment when brought on the Site, between sample locations, when necessary between sample intervals, and before removing it from the Site. Certain disposal equipment meant to be used only once and discarded will be decontaminated prior to use, unless the equipment is properly packaged and sealed. All non-disposable components of the sampling equipment that will not have direct contact with the samples collected (i.e., augers, probe rods, drill pipe, etc.) will be decontaminated as follows:

- Potable water rinse;
- Liqui-nox® detergent wash;
- Potable water rinse;
- De-ionized (DI) water rinse (3 times); and
- Air dry.

All sampling equipment that contacts the soils, groundwater, sediments, or surface waters that will be submitted for analyses (i.e. coring equipment, compositing bowls, scoops and spoons) will be decontaminated as follows:

- Potable water rinse;
- Liqui-nox® detergent wash;
- DI water rinse;
- Liqui-nox® detergent wash;
- DI water rinse (3 times); and
- Air dry.

A methanol or hexane rinse may be used if evidence of organic staining is found after equipment has been cleaned. Equipment rinsate blank samples will be collected as specified in the QAPP to document the effectiveness of decontamination. Following decontamination, the sampling equipment will be placed in bags or sealed to keep the equipment clean during storage.

All liquids generated as a result of decontamination processes will be containerized and handled as IDW as detailed in Section 7.0.

5.11 SURVEYING

Following completion of field activities, a licensed surveyor will survey the horizontal coordinates and vertical elevations of the monitoring wells and the staff gauges with a vertical accuracy of 0.01 feet at each sampling location. Other sampling stations (soil borings, surface water sampling stations, sediment stations, and fish tissue sampling stations) will be surveyed in the field with the differential GPS meter. Since the temporary piezometers will be installed for a short period of time (about 48 hours), the ground surface adjacent to the temporary piezometers will be surveyed. The top of casing elevation for the piezometers will be calculated based on the ground elevation and the height of the temporary casing above the ground surface. All horizontal coordinates will be referenced to the Texas State Plane Coordinate System, North American Datum from 1983, and elevations will be surveyed relative to the National Geodetic Vertical Datum of 1988.

6.0 SAMPLE HANDLING AND ANALYSIS

6.1 SAMPLE HANDLING

To prevent misidentification of samples, labels will be affixed to each sample container. Information will be written on the label with a permanent marker. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Project identification number;
- Sampling station identification name;
- Name or initials of collector;
- Date and time of collection;
- Analysis required (if space on label allows); and
- Preservative inside bottle, if applicable.

Sample aliquots will be containerized in order of decreasing analyte volatility. Sample containers will be filled in the following sequence: VOCs; extractable organics (including SVOCs and PCBs); pesticides; and then metals and other analyses.

Samples will be placed in shipping coolers containing bagged, cubed ice immediately following collection. The samples will be grouped in the shipping cooler by the order in which the samples are collected. Samples will be shipped to the laboratory via an overnight courier service, generally on the day they are collected. The only exceptions to this procedure will be for samples collected after the courier service has picked up the shipment for the day and samples collected on a Sunday or holiday. In these instances, the samples will be shipped on the next business day. Specific protocols are included in PBW SOP-6: Sample Custody, Packaging and Shipment (Appendix A).

6.1.1 Sample Preservation

Appendices A through D in the QAPP identifies the requirements for the number of containers, container volume, container type (material of construction), preservation, and holding time periods for each of the analytical methods.

6.1.2 Sample Chain-Of-Custody Forms and Custody Seals

Evidence of collection, shipment, and laboratory receipt must be documented on a Chain-of-Custody record by the signature of the individuals collecting, shipping and receiving each sample. A sample is considered in custody if it is:

- In a person's actual possession;
- In view, after being in physical possession;
- Sealed so that no one can tamper with it, after having been in physical custody; and/or
- In a secured area restricted to authorized personnel.

Chain-of-Custody Records will be used, by all personnel, to record the collection and shipment of all samples. The Chain-of-Custody Record may specify the analyses to be performed and should contain at least the following information:

- Name and address of originating location of samples;
- Name of laboratory where samples are sent;
- Any pertinent directions/instructions to laboratory;
- Sample type (e.g., aqueous);
- Listing of all sample bottles, size, identification, collection date and time, and preservative, if any, and type of analysis to be performed by the laboratory;
- Sample ID;
- Date and time of sample collection; and
- Signature of collector as relinquishing, with date/time.

The Chain-of-Custody procedure will be as follows:

1) The field technician collecting the sample shall be responsible for initiating the Chain-of-Custody Record. The names of all members of the sampling team will be listed on the Chain-of-Custody Record. Samples can be grouped for shipment on a common form.

2) Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and note the date and time.

3) The Chain-of-Custody Record shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier. The carrier waybill shall serve as an extension of the Chain-of-Custody Record between the final field custodian and receipt in the laboratory. The commercial carrier is not considered part of the COC chain and is not required to sign the COC.

4) Upon receipt in the laboratory, a designated individual shall open the shipping containers, measure and record cooler temperature, compare the contents with the Chain-of-Custody Record, and sign and date the record. Any discrepancies shall be noted on the Chain-of-Custody Record.

5) If discrepancies occur, the samples in question shall be segregated from normal sample storage and the project manager will be notified for clarification.

6) Chain-of-Custody Records, including waybills, if any, shall be maintained as part of the project records.

6.2 SAMPLE ANALYSIS

As presented on Table 5, samples with be analyzed using the analytical methods listed for each media. Following the EPA guidance document titled "Guidance for Data Usability in Risk Assessment" (EPA, 1991), Method Selection Worksheets were prepared for soil, groundwater, surface water, and sediment as provided in Appendix B as Tables B-1 through B-4, respectively. The tables list the COIs that will be analyzed for each media sampled, with the exception of fish tissue. The COIs for fish tissue will be established following the sediment sampling of the Intracoastal Waterway as detailed in the RI/FS Work Plan. The tables also list the PSVs, as defined in the RI/FS Work Plan, for each COI with the required method detection limits.

6.3 FIELD DOCUMENTATION

Field data will be recorded on standard forms (e.g., stratigraphic logs), as detailed in PBW SOP No. 1 – Field Documentation. Field data primarily will be direct observations, hand measurements, direct-readings from field meters. These data will be tabulated and included in project reports or submittals, as appropriate. Appropriate field forms will be used to record field data collection activities.

Entries will be described in as much detail as possible to ensure that a particular situation could be reconstructed only from field entries. Entries will include the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be entered. The names of individuals visiting the site or field sampling team and the purpose of their visit will also be recorded. All field measurements obtained and samples collected will be recorded on the appropriate forms. All entries will be made in ink, signed and dated. If an incorrect entry is made, the incorrect information will be crossed out with a single strike mark that is initialed and dated by the person making the erroneous entry. The correct information will be entered adjacent to the original entry.

Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded on the appropriate form. Photographs taken at a location, if any, will also be noted in the daily field form. All equipment used to obtain field measurement as well as the field calibration data will be recorded on the appropriate field forms.

Samples will be collected following the sampling procedures documented in this FSP. The equipment used to collect samples, time of sample collection, sample description, volume and number of containers, preservatives added (if applicable) will be recorded on the appropriate field forms. The field forms will be filed in the PBW Office project files.

7.0 MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

IDW generated from borings or monitoring wells will be placed in Department of Transportation (DOT)-approved drums and managed for off-site disposal. These wastes will be characterized following the RI activities. The IDW will then be classified based on the analytical results and disposed of accordingly. An area at the Site will be designated by the Field Supervisor for the staging of drums awaiting characterization and disposal. Management of IDW is further described in PBW SOP No. 14: Storage and Disposal of Soil, Drilling Fluid, and Water Generated During Field Work (Appendix A). The following general parameters will be followed to characterize the IDW at the Site:

- Use process knowledge and data from environmental media samples to assist in the evaluation and classification of IDW, where possible (e.g., groundwater sample data can be used to evaluate classification of well development and purge water).

- Collect composite samples from specific IDW waste streams, where environmental media data are not available (e.g., water collected after decontamination of drilling equipment).

- Analyze each sampled IDW waste stream in accordance with applicable state and federal regulations, and in accordance with any facility-specific requirements of potential waste management (recycling/disposal) facilities.

Upon completion of RI activities, the IDW will be transported to appropriate off-site waste management facilities or otherwise managed in accordance with all applicable state and federal regulations. All records documenting the IDW characteristics, waste classifications, quantities, final management locations, and waste manifest forms will be filed in the project files.

8.0 FIELD HEALTH AND SAFETY PROCEDURES

The overall health and safety objective is to perform the field tasks in a manner that minimizes the potential for accidents or injuries, and minimizes the potential for worker exposure to hazardous chemicals. Details of the health and safety procedures are provided in the Site-Specific Health and Safety Plan (HSP) (PBW, 2005), dated August 17, 2005.

The HSP applies to the field activities described in this FSP that will be performed during the RI/FS at the Site. The HSP was prepared to comply with the requirements of 29 CFR 1910.120 (b)(4). The primary purpose of the plan is to provide the results of a hazard assessment conducted for the prescribed work tasks, and the health and safety requirements and protocols that will minimize hazards to site workers.

A copy of the HSP will be kept on site at all times during field activities. All personnel will complete the Safety Compliance Agreement provided in Appendix A of the HSP. Other health and safety documentation are detailed in the HASP.

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TABLES

TABLE 1 - SAMPLE DESIGN COLLECTION WORKSHEET

Medium	Exposure Routes	Number of Samples			
		Judgmental/ Random	Background	QC[2]	Medium Total
Soil	1. Inhalation of particulates in ambient air resulting from fugitive dust generation and/or contact with/ingestion of particles deposited on surface soil. 2. Exposure to soil via ingestion and dermal contact. 3. Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.	257	TBD[1]	65	322
Groundwater	1. Inhalation of vapors that have migrated from groundwater through the soil pore space and into ambient air. 2. Exposure to potable water through ingestion, dermal contact, ingestion of crops that were irrigated with water, and inhalation of vapors emitted from water as a result of COI leaching to groundwater.	25	TBD[1]	13	38
Sediment	1. Ingestion of and dermal contact with sediments as a result of surface runoff of COIs from PSAs. 2. Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.	56	9	17	82
Surface Water	1. Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of surface runoff of COIs from PSAs. 2. Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of COI leaching to groundwater, groundwater discharge to surface water.	25	4	13	42
Fish Tissue	1. Ingestion of finfish and crabs from the Intracoastal Waterway near the Site.	36	36[3]	4	76
	Column Totals	399	49	112	560
				Grand Total:	560

Notes:

1. TBD - To be determined. The need for background soil and groundwater water samples will be evaluated after initial Site data are obtained.
2. Number of QC Samples estimated (exact number of QC samples may change depending on field schedule).
   QC samples include: Matrix spike/duplicate: 1 per 20 samples per media.
   Field duplicate : 1 per 20 samples per media (except 1 per fish species sampled).
   Equipment rinsate blank : 1 per day/team for activities that require an equipment blank.
   Field blank : 1 per day/team.
   Trip blank (volatiles only) : 1 per sample cooler per day.
3. Analyses contingent on Site fish tissue data results.
4. Ecological pathways will be identified in the Ecological Problem Formulation Report.

TABLE 2 - MEDIA SAMPLE SUMMARY

Sample Area	Media	Number of Sample Stations[1]	Sample Quantity	Chemical Analysis								
				VOCs[2]	SVOCs	Metals	PCBs[3]	Pesticides	Fate & Transport[4]	TOC/ Grain Size	Anions/ Cations	Geotech[5]
Potential Source Areas												
Former Aboveground Storage Tank (AST) Tank Farm Area	Soil	7	14	X	X	X	X	X				
	Groundwater	3	3	X	X	X	X	X			X	
Pipelines	Soil	9	18	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Former Surface Impoundment Area	Soil	8	16	X	X	X	X	X				
	Geotechnical	4	4									X
	Groundwater	8	8	X	X	X	X	X			X	
Former Wash Water Storage Tank Area	Soil	3	6	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Electrical Shed	Soil	4	8				X					
Sand Blasting Areas	Soil	9	18	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Welding Area	Soil	20	40	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Dry Dock Area	Soil	7	14	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X				
Surface Drainage Areas	Soil	5	10	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Former Septic Tank Areas	Soil	6	12	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Former Product Storage Tank Area	Soil	3	6	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Former Gasoline Storage Tank Area	Soil	2	4	X	X	X	X	X				
Lot 21 Area	Soil	15	30	X	X	X	X	X				
	Surface soil (0-1in)	10	10			X						
	Groundwater	1	1	X	X	X	X	X			X	
Other Areas												
Random Systematic Sample Locations	Soil	23	46	X	X	X	X	X	X			
	Sediment	17	17	X	X	X	X	X		X		
	Groundwater[6]	2	2	X	X	X	X	X			X	
Residential Surface Soil Investigation	Surface soil (0-1in)	49	49			X						
Wetlands (Off-Site)	Sediment	15	15	X	X	X	X	X		X		
	Surface water	15	15	X	X	X	X	X				
Fresh Water Ponds (Large and Small)	Sediment	8	8	X	X	X	X	X		X		
	Surface water	6	6	X	X	X	X	X				
Perimeter Groundwater Locations	Groundwater	7	7	X	X	X	X	X			X	
Intracoastal Waterway	Sediment	25	25	X	X	X	X	X		X		
	Surface Water[7]	8	8	X	X	X	X	X				
	Fish Tissue[8]	5	72	TBD[7]	TBD	TBD	TBD	TBD				
All Areas	NAPL	*[9]	*	X	X		X					

Notes:
1. Sample locations were counted more than once for stations locations used for multiple PSAs.
2. VOC analyses not performed on soil samples from the 0 to 6 inch depth interval.
3. PCB congeners will be analyzed on the soil samples collected from the Electric Shed, and on 10% of the samples collected site-wide.
4. Fate and transport characterization samples (foc, pH, bulk density) will be collected from three North Area sample station and three South Area sample station.
5. Geotech analyses will consist of sieve analysis, Atterberg Limits, and vertical hydraulic conductivity.
6. Two temporary piezometers will be installed in the areas southwest of the Former Surface Impoundments.
7. Surface water samples from the Intracoastal Waterway will be collected from four zones adjacent to the Site (one sample each) and from one background area (four samples).
8. Fish tissue will be analyzed for the suite of analyses to be determined (TBD) based on the Intracoastal Waterway sediment results. Fish tissue samples will be collected from four zones (36 samples) and from a background location (36 samples).
9. * If NAPL is detected in any of the monitoring wells at the Site, a sample will be collected and analyzed for the analytical suites marked.

TABLE 3 - TARGET FISH SPECIES AND LEGAL SIZE LIMITS

Species	Scientific Name	Legal Size and Target Length (in)	Number of Site Samples[1]	Organisms per Sample[2]
Red Drum	*Sciaenops ocellatus*	20 - 28	9	1
Spotted Sea Trout	*Cynoscion nebulosus*	15 - 25	9	1
Southern Flounder	*Paralichthys lethostigma*	14 – No Limit	9	1
Blue Crab	*Callinectes sapidus*	5 – No Limit	9	5-10

Note:
1 - Background samples will be archived at the laboratory with analysis pending the Site sample results.
2 – If a single fish can not provide the required sample volume, the fillets from multiple fish will be composited

TABLE 4 - FIELD EQUIPMENT

Task	Equipment[1]
Former Surface Impoundment Cap Evaluation	Hand Auger/Drill Rig
Surface Geophysical Survey	EM-61 Metal Detector RD-400 Radiodetection Meter RTK-GPS Unit
Soil Investigation	Organic Vapor Meter/Photoionization Detector Hand Auger/Drill Rig Trowel/Spade RTK-GPS Meter
Groundwater Investigation	Drill Rig Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) Interface Probe Conductivity Probe for NAPL [2] Water Level Probe Peristaltic pump/flow-through cell Geophysical Logging Tool
Surface Water Investigation	Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) Dipper, Bailer, or peristaltic pump Water line (for depth)
Sediment Investigation	Ekman dredge/piston corer Hand auger RTK-GPS Unit Mixing bowls, spoons, knives
Fish Tissue Investigation	Gill Nets (for finfish) Fishing Poles Fish Bags Crab traps (Blue crabs) Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) for water RTK-GPS Meter

Note:

1. Additional or equivalent equipment may be used.
2. See RI/FS Work Plan

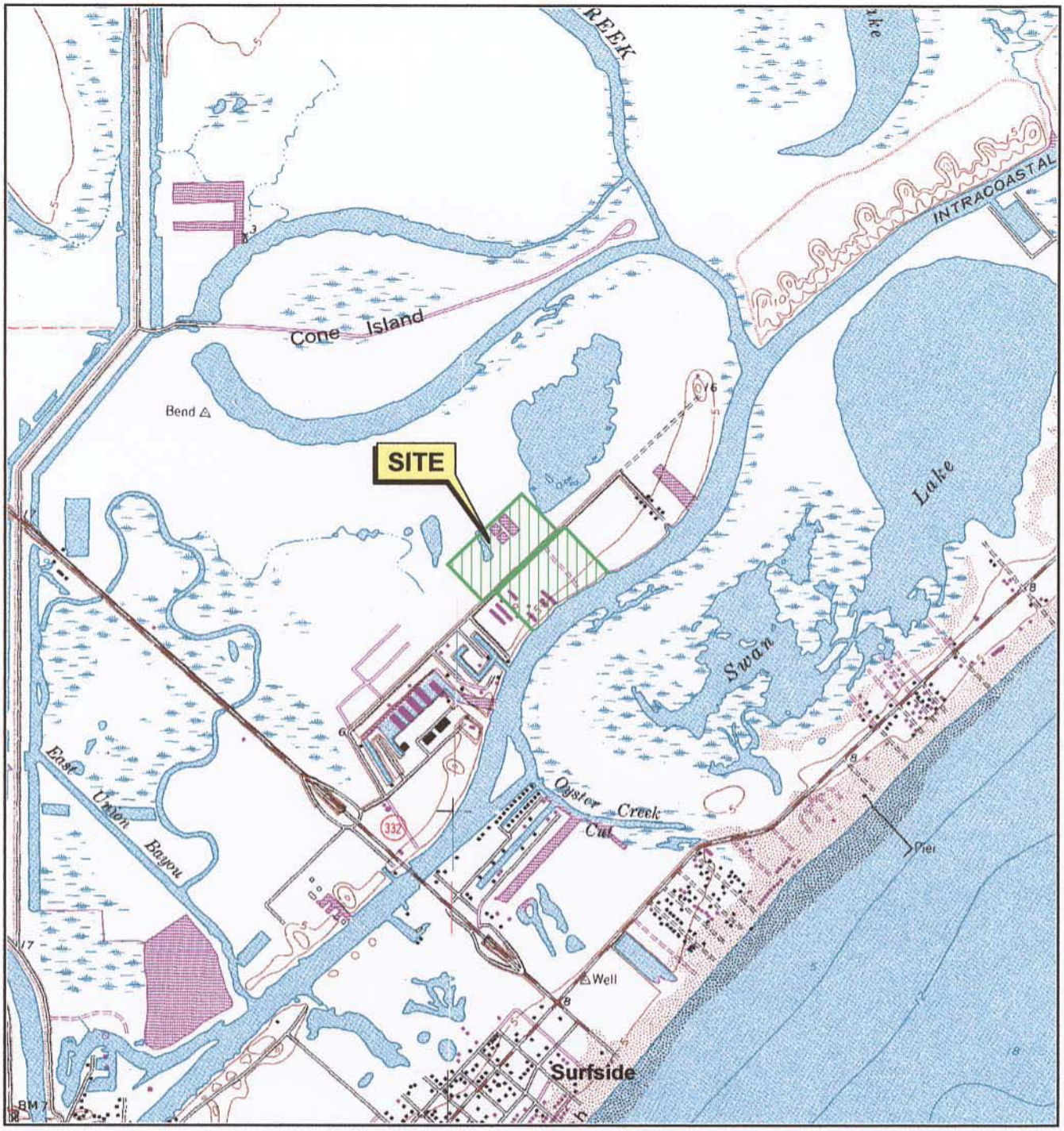
TABLE 5 - SUMMARY OF ANALYTICAL METHODS

SAMPLE TYPE	SAMPLE ANALYSES	ANALYTICAL METHOD[1]
Soil (cap)	Percent Passing No. 200 Sieve	ASTM D 1140[2]
	Atterburg Limits	ASTM D 4318[2]
	Vertical Hydraulic Conductivity	COE EM-1110-2-1906[3]
Soil	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals	EPA 6010B
	Mercury	EPA 7471A
	Moisture Content (Total Percent Solids)	Std. Methods 2540G[4]
Soil (fate & transport)	Soil Bulk Density	
	pH	EPA 9045
	Total Organic Carbon	EPA 415.1/9060
Groundwater	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals	EPA 6010B
	Mercury	EPA 7470A
Groundwater	Total Dissolved Solids	EPA 160.1[5]
	Total Suspended Solids	EPA 160.2[5]
	Major Anions (Ca, Mg, K, Na)	EPA 6010B or 6020
	Major Cations (SO_4, Cl)	EPA 9038 and 9251
	Alkalinity (Field)	Hach 8203[6]
NAPL	Specific Gravity	
	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
Surface Water	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals (filtered and unfiltered)	EPA 6010B
	Mercury	EPA 7470A
	Hardness	EPA 220.7[5]
	Total Suspended Solids	EPA 160.2
Sediment	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals (filtered and unfiltered)	EPA 6010B
	Mercury	EPA 7470A
	Total Organic Carbon	EPA 415.1/9060
	Grain-Size Distribution	ASTM C-136[2]

TABLE 5 - SUMMARY OF ANALYTICAL METHODS

Notes:
1. Unless indicated otherwise, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method from "ASTM 2005 Annual Book of Standards", Vol. 04.08.
3. Method from U.S. Army Corps of Engineers Manual, Appendix VII, 30 November 1970 (for falling-head tests).
4. Method from "Standard Methods for Examination of Water and Wastewater."
5. Method from EPA 600/4-79-020 "Methods for Chemical Analysis of Water and Wastes."
6. Method from Hach Water Analysis Handbook.

FIGURES



TEXAS

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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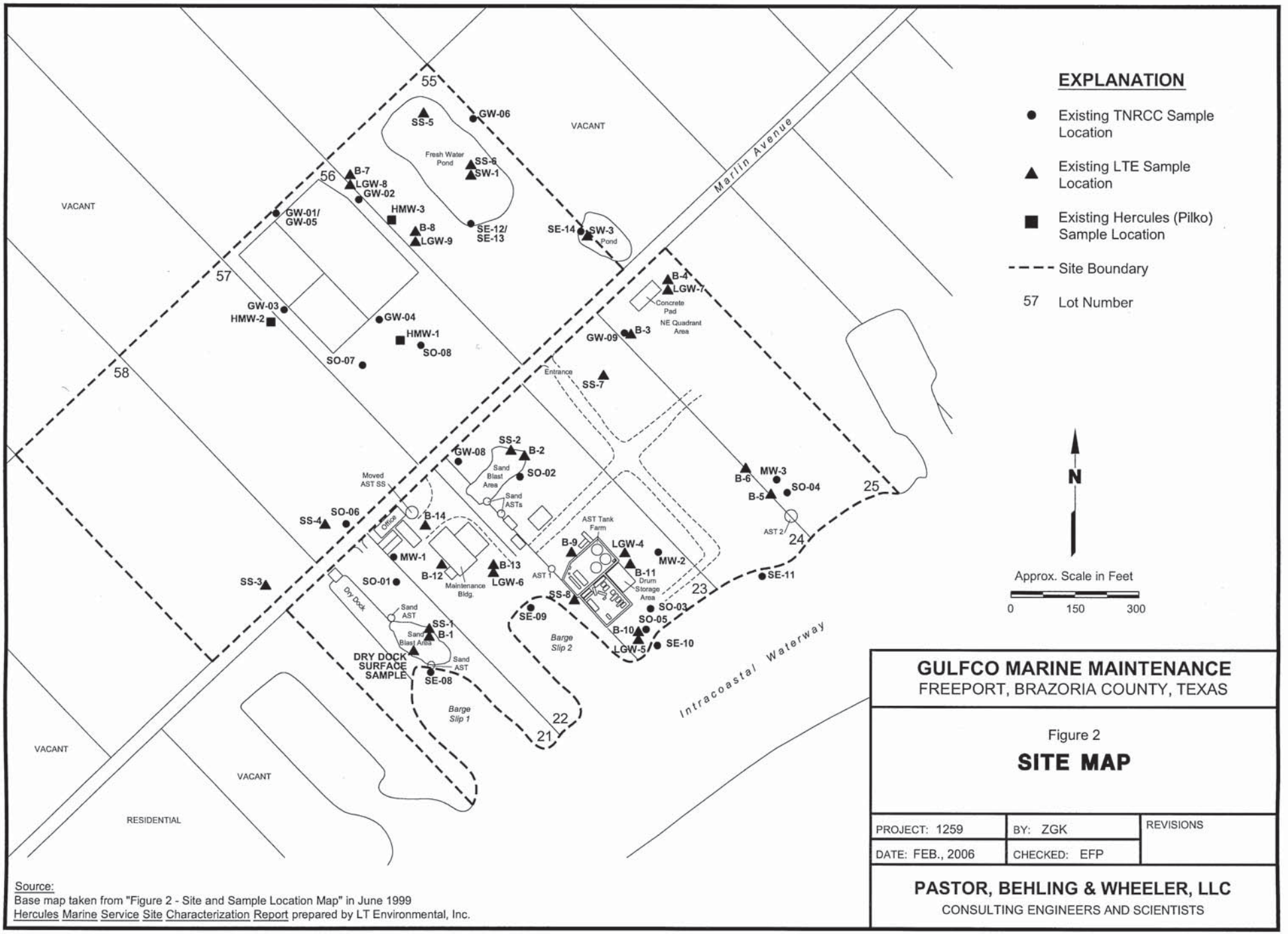

Source:
Base map taken from "Figure 2 - Site and Sample Location Map" in June 1999
Hercules Marine Service Site Characterization Report prepared by LT Environmental, Inc.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2

SITE MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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EXPLANATION

FS
Fill and Spoil

Qal
Alluvium

Qbr
Beach-ridge and barrier-flat sand deposits

Holocene

QUATERNARY

N

SCALE

0 1

Statute Miles

Source: Geologic Atlas of Texas, Beeville-Bay City Sheet, 1987.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 3

REGIONAL GEOLOGY MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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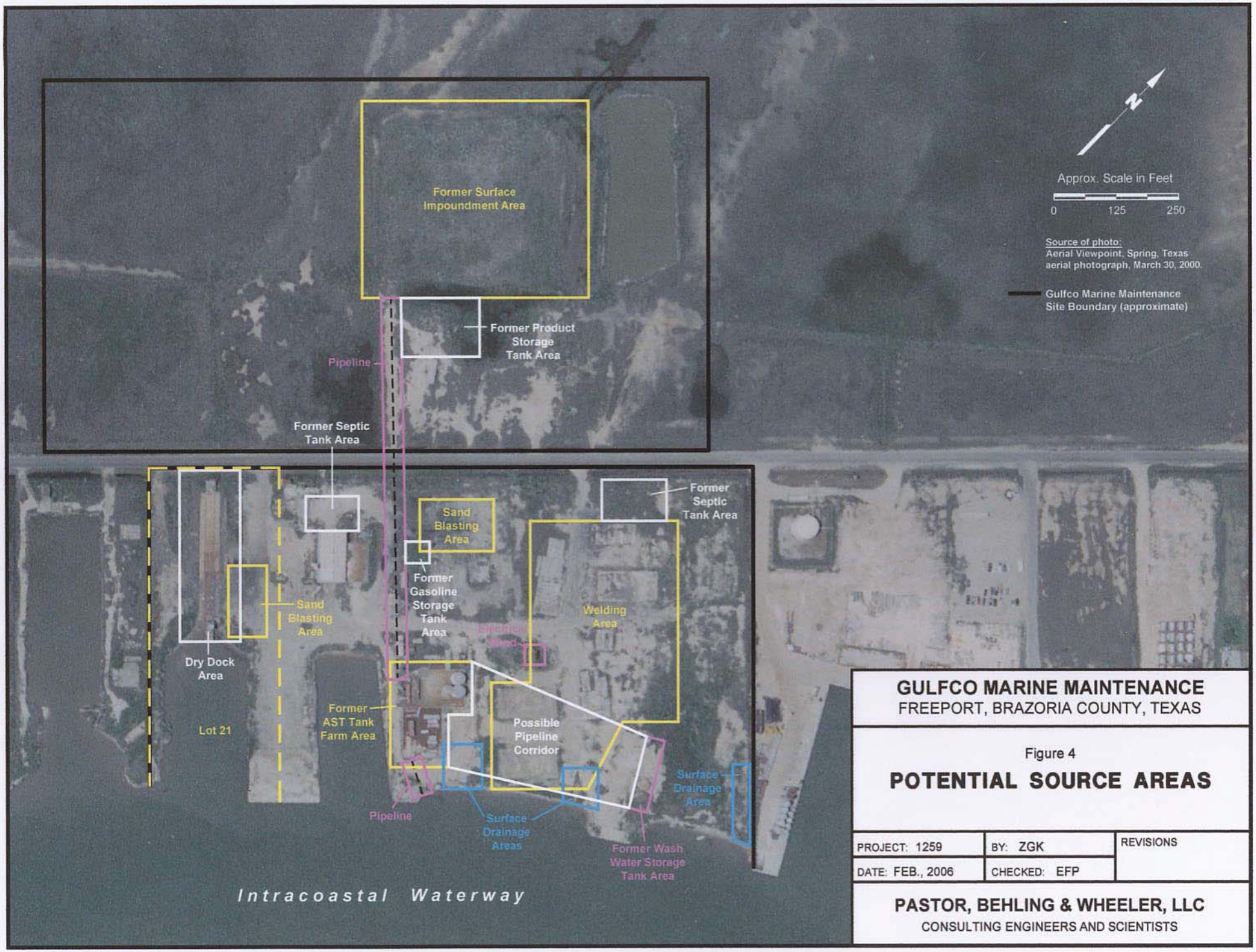

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 4

POTENTIAL SOURCE AREAS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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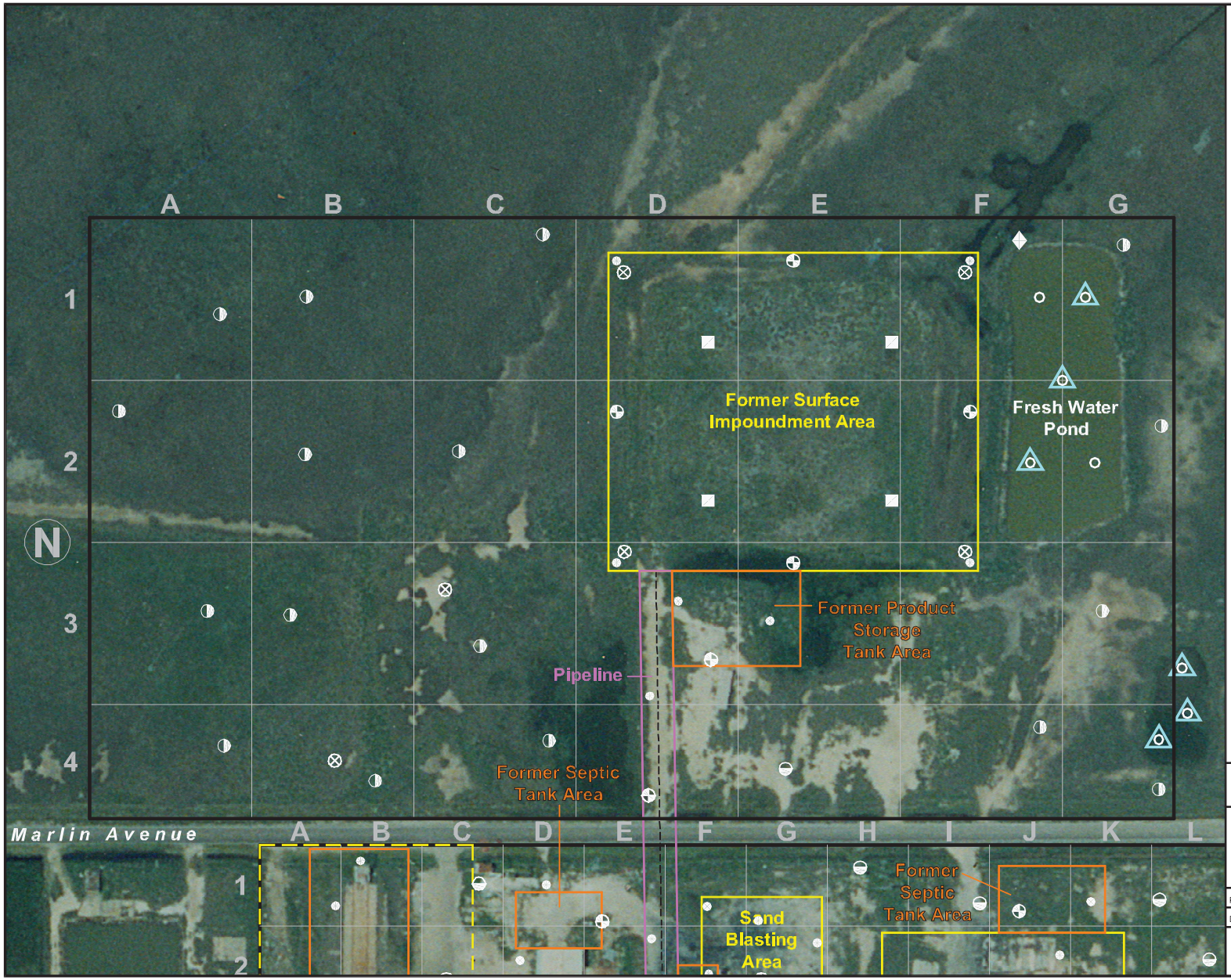

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge
- Surface Water Sample (Fresh Water and Small Pond)

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

SAMPLE LOCATIONS NORTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6

SAMPLE LOCATIONS SOUTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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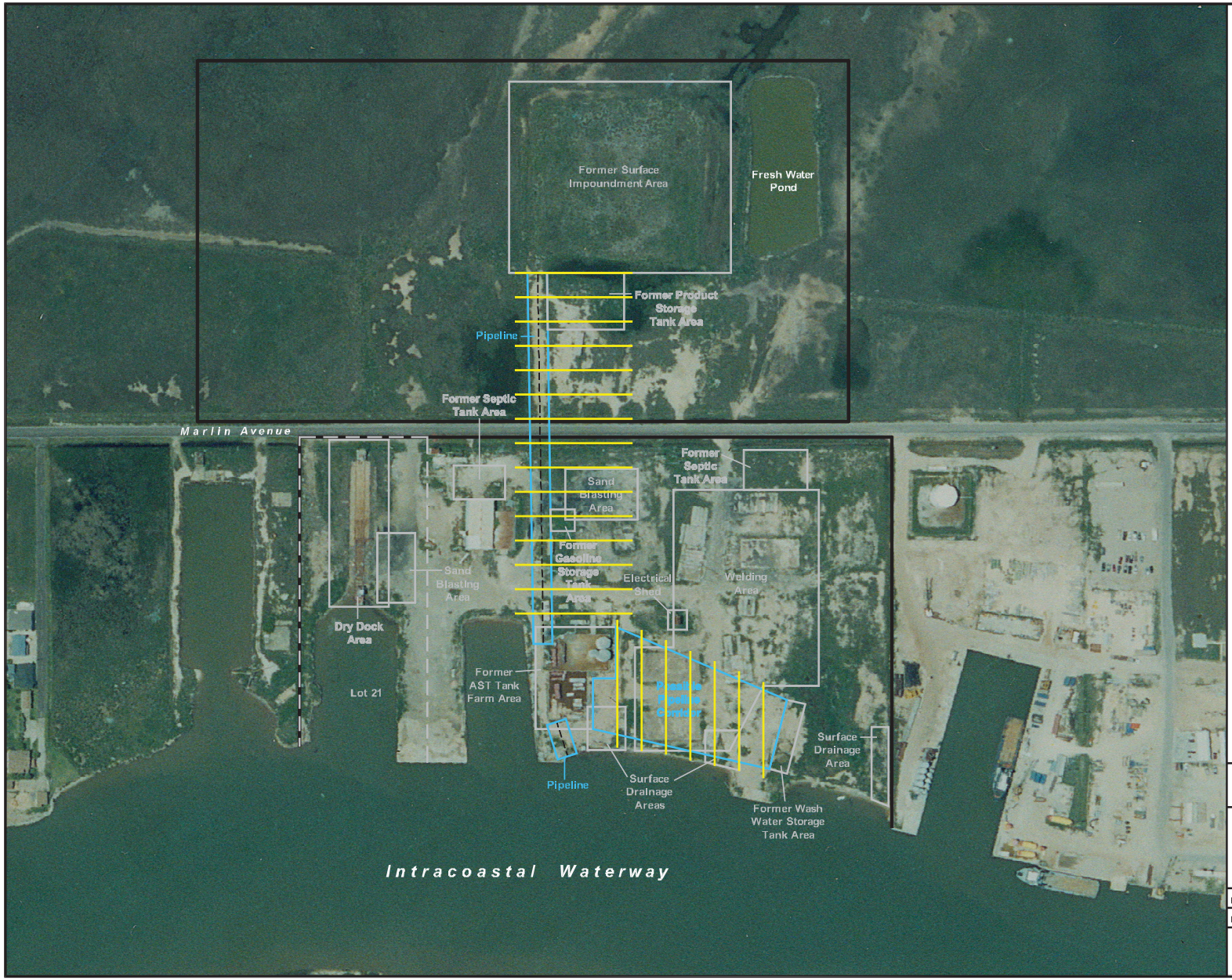

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- EM Survey Transect

Approx. Scale in Feet

0 100 200

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 7

EM SURVEY TRANSECTS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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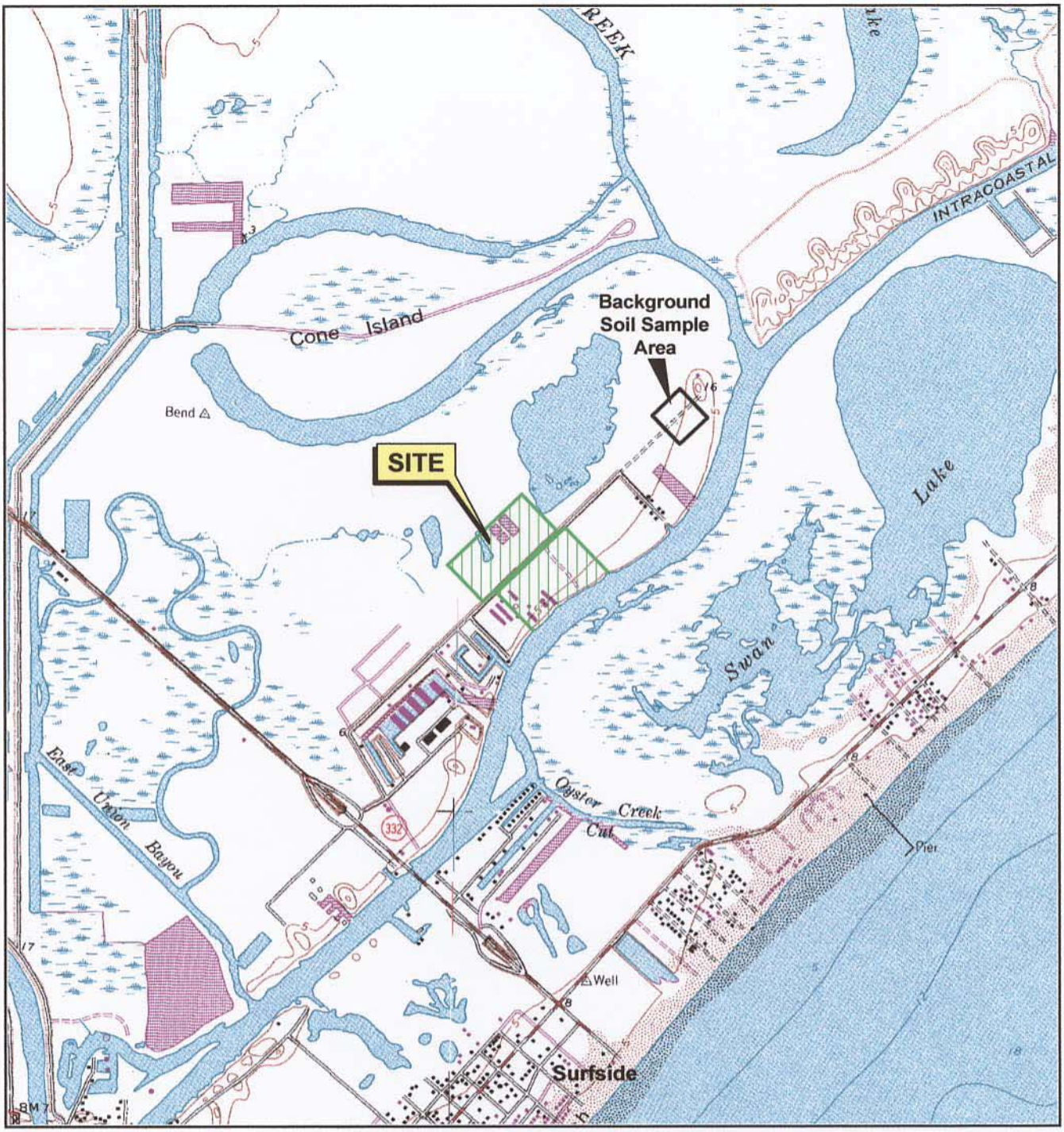

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 8

BACKGROUND SOIL SAMPLE LOCATION

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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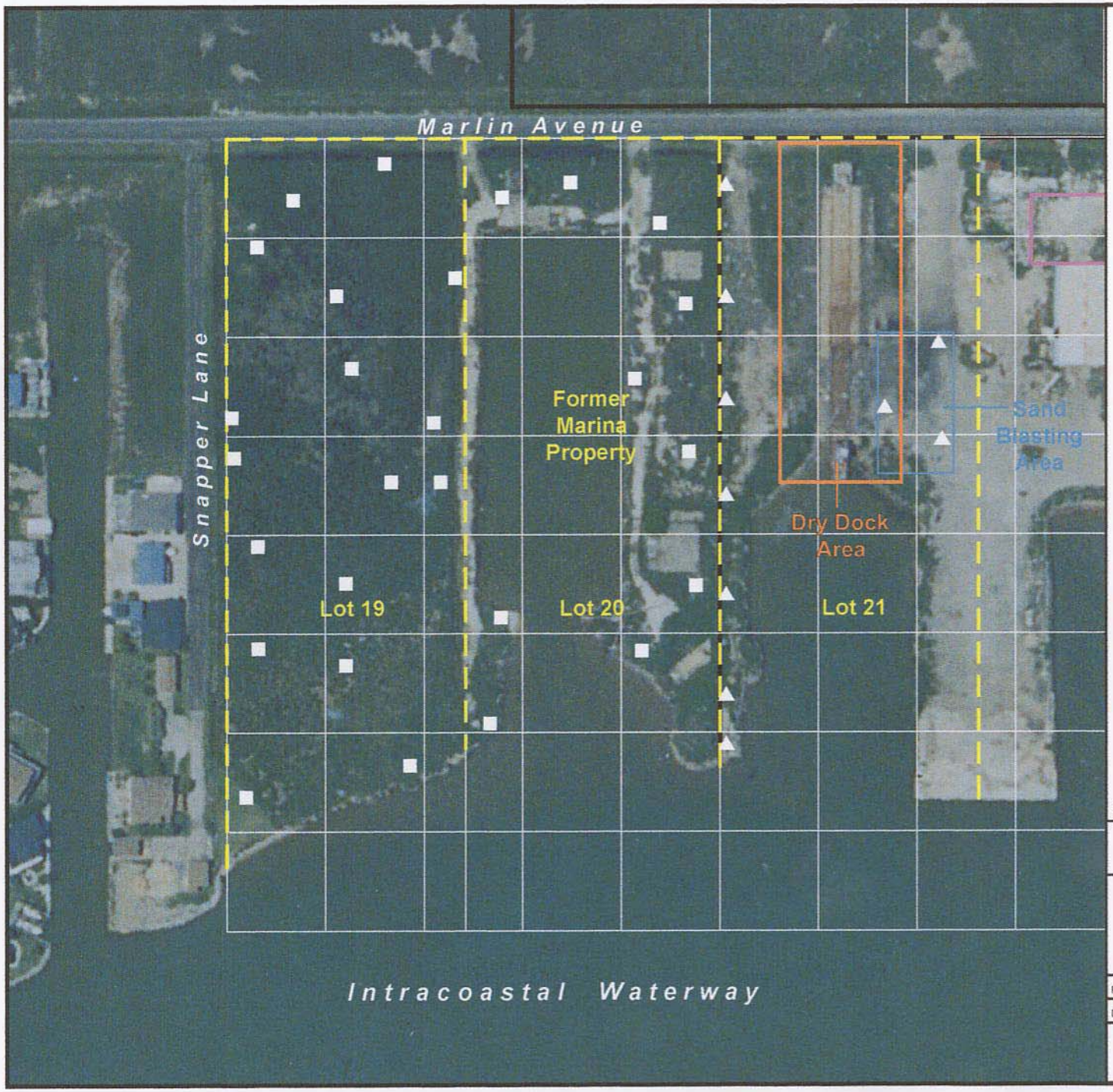

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ▲ Lot 21 Surface Soil Sample (0-1 in)
- ■ Lot 19/20 Surface Soil Sample (0-1 in)

Notes:
Soil sample locations subject to change based on field conditions. Composite samples also to be collected from residential properties on west side of Snapper Lane. Specific locations will be determined based on building locations and thus are not shown on this figure.

N

Approx. Scale in Feet

0 75 150

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 9

RESIDENTIAL SURFACE SOIL INVESTIGATION SAMPLE LOCATIONS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Sediment / Crab Tissue Sample Location
- Zone 1 — Surface Water / Fish Netting Station Zone

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 10

SURFACE WATER/SEDIMENT/FISH TISSUE SAMPLE LOCATIONS-INTRACOASTAL WATERWAY

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Lot-21 Random Systematic and Judgmental Soil Sample (0-1 in)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Surface Water Sample (Fresh Water and Small Pond)
- Off-Site Wetland Surface Water and Sediment

Approx. Scale in Feet

0 80 160

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 11

OFF-SITE WETLAND SURFACE WATER AND SEDIMENT SAMPLE AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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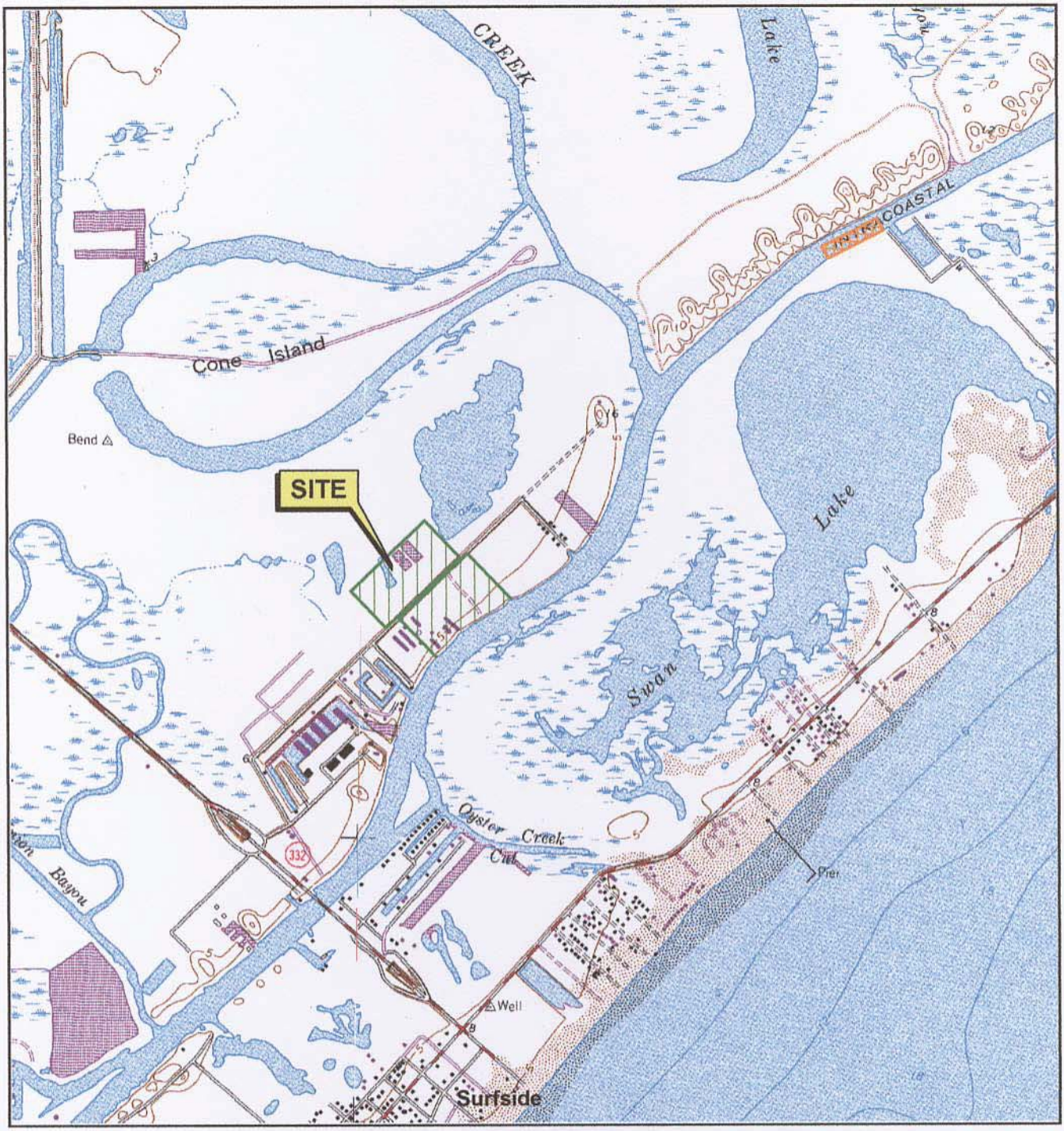

EXPLANATION

- Approx. Site Boundary
- Background Sediment/ Fish Tissue Sample Location

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 12

BACKGROUND SURFACE WATER/ SEDIMENT/FISH TISSUE SAMPLE LOCATION

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDIX A
STANDARD OPERATING PROCEDURES

PASTOR, BEHLING & WHEELER, LLC

LIST OF STANDARD OPERATING PROCEDURES

SOP Number	Title	Revision No. and Date
1	FIELD DOCUMENTATION	Rev No. 1 Sept. 2005
2	SUPERVISION OF EXPLORATORY BORINGS	Rev No. 2 Oct. 2005
3	FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES	Rev No. 1 Sept. 2005
4	GEOPHYSICAL LOGGING	Rev No. 0 Sept. 2005
5	SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS	Rev No. 1 Oct. 2005
6	SAMPLE CUSTODY, PACKAGING AND SHIPMENT	Rev No. 0 Dec. 2002
7	INSTALLATION OF MONITORING WELLS AND PIEZOMETERS	Rev No. 1 Sept. 2005
8	MONITORING WELL DEVELOPMENT	Rev No. 0 Jan. 2005
9	WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT	Rev No. 1 Sept. 2005
10	WATER QUALITY SAMPLING	Rev No. 1 Sept. 2005
11	FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)	Rev No. 0 Dec. 2002
12	FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)	Rev No. 0 Dec. 2002
13	EQUIPMENT DECONTAMINATION	Rev No. 0 Dec. 2002
14	STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK	Rev No. 0 Dec. 2002
15	HYDRAULIC TESTING	Rev No. 1 Sept. 2005
16	DATA VALIDATION (included in SAP Volume II – QAPP)	Rev No. 1 Oct. 2005

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 1

FIELD DOCUMENTATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol for documenting field activities. PBW field personnel shall document field activities on formatted field records and other appropriate data sheets. These formatted record and data sheets will be part of the PBW project file; all forms must be filled out carefully and completely by one of the personnel actually performing the field activities.

2.0 PROCEDURES

2.1 Daily Field Record

The PBW field representative will prepare a Daily Field Record form (Figure SOP-1-1) for each day of field work. As appropriate, documentation on the multiple-page form will include:

A. Project identification;

B. Date;

C. Time on job (beginning and ending time);

D. Weather conditions;

E. Activity description;

F. List of personnel and visitors on site;

G. Safety equipment used and monitoring performed;

H. Waste storage inventory (if any);

I. Chronological record of activities and events;

J. Comments and variances from project work plan;

K. Content of telephone conversations; and

L. Signature of the PBW field representative.

The PBW field representative will document details as necessary to recreate the day's activities and events at a later time, using as many additional sheets as needed. The Daily Field Record also can be used to document field activities that may not be specified on other field record forms. Other activity-specific documentation requirements that can be recorded on the Daily Field Record are discussed in the PBW Standard Operating Procedure (SOP) for each activity.

3.0 DOCUMENTATION

3.1 Field Record Forms

In addition to the Daily Field Record, PBW field personnel will complete specific PBW field record forms applicable to the field activities being conducted. The procedures for completion of activity-specific field record forms are presented in the applicable PBW Standard Operating Procedures. Some of the PBW field record forms include:

- Daily Field Record (SOP No. 1);
- Log of Boring (SOP No. 2);
- Chain-of-Custody Record and Request for Analysis (SOP No. 6);
- Monitoring Well Installation (SOP No. 7);
- Monitoring Well Development (SOP No. 8);
- Water Level Monitoring Record (SOP No. 9);
- Groundwater Sampling Record and Surface Water Sampling Record (SOP No. 10);
- Eh Data Sheet (SOP No. 11); and
- Slug Test Form (SOP No. 15).

3.2 Records Management

All original field forms will be filed with the appropriate project's records.

4.0 QUALITY ASSURANCE

4.1 Form Review and Filing

Completed field forms should be reviewed by the Project Manager or project designated QA/QC reviewer. Any necessary corrections will be made in pen with a single-line strike out that is initialed and dated.

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD	DATE:	PAGE 1 of _____

Project Number: Project Name:

Location: Time on Job: AM/PM to: AM/PM

Weather Conditions:

Activity:

PERSONNEL ON SITE

Name	Company	Time In	Time Out

VISITORS ON SITE

Name	Company/Agency	Time In	Time Out

PERSONAL SAFETY

	Protective Gloves		Hard Hat		Tyvek Coveralls
	Protective Boots		Safety Goggles/Glasses		Respirator (Half/Full)
	Hearing Protection				

Other Safety Equipment (describe):

SAFETY EQUIPMENT

Monitoring Equipment:	Serial / Rental No.	**Field Calibration:** Std.	Result

WASTE STORAGE INVENTORY

Container Type	Container ID	Description of Contents and Quantity	Location

SIGNATURE OF FIELD REPRESENTATIVE:

DATE:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664

Phone: (512) 671-3434 Fax: (512) 671-3446

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD *(continued)*	DATE:	PAGE _____ of _____

TIME	DESCRIPTION OF DAILY ACTIVITIES & EVENTS

COMMENTS / COMMUNICATIONS:

SIGNATURE OF FIELD REPRESENTATIVE:	**Pastor, Behling & Wheeler, LLC** **2201 Double Creek Drive, Suite 4004** **Round Rock, Texas 78664**
DATE:	**Phone: (512) 671-3434 Fax: (512) 671-3446**

Pastor, Behling & Wheeler, LLC.

STANDARD OPERATING PROCEDURE No. 2

SUPERVISION OF EXPLORATORY BORINGS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed by Pastor, Behling & Wheeler, LLC (PBW) personnel during the drilling and logging of exploratory borings. Exploratory borings (pilot holes) may be drilled to obtain samples of the subsurface strata or to run borehole geophysical logs. Borings will be either backfilled with grout or completed as monitoring wells or piezometers.

The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Drilling

For any site or drilling location, the selection of drilling methods will be based on: (1) availability and cost of the method; (2) suitability for the type of geologic materials at the site (e.g., consolidated, unconsolidated); (3) potential effects on sample integrity (influence by drilling fluids and potential for cross contamination between aquifers); or (4) or other site-specific considerations. Some commonly used drilling methods include hollow-stem auger method, cone penetrometer testing (CPT) method, direct-push geoprobe method, hydraulic rotary method, cable tool method, or casing-hammer air rotary method. Synthetic polymer drilling fluid additive should be used only if a boring: (1) will not be sampled for chemical analysis; (2) will not be completed as a monitoring well; or (3) if cuttings return and/or borehole integrity cannot be achieved by any other method.

Exploratory borings for monitoring wells and piezometers will be drilled in a manner that will minimize the potential for cross contamination between water-bearing units. The actual depth of

each exploratory boring will be specified by the PBW field supervisor assigned to the drill rig and will be based on the intended use of the boring. No solvents or petroleum-based products will be used for lubricating any drilling equipment (rods, bit, augers, mud pit, etc.) which will contact the borehole or the drilling fluid. For air rotary drilling, an air filter will be installed between the air compressor and the drill pipe to intercept oil droplets.

The drilling equipment in which fluid (including air) circulates, including drive samplers and bits, will be thoroughly steam cleaned before and after drilling of each exploratory boring. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (e.g., 0.1 N HCl) or solvent rinse (e.g., methanol or hexane) may be used to supplement these procedures if tarry or oily deposits are encountered during drilling. Drilling equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

To ensure that the specified equipment has been provided by the drilling contractor, prior to drilling the PBW field supervisor will measure and record the outside diameter of the drill bit or augers and, when using the hollow stem auger method, the inside diameter of the augers.

During drilling, the PBW field supervisor may choose to periodically measure and record the depth to water within the drill casing. The position of the lead drill casing will be recorded each time a water level measurement is taken. When the total depth of a boring is reached, the water level within the drill casing will be measured.

If the boring is to be completed as a monitoring well or a piezometer, the final borehole diameter will be sufficiently large to allow placement of a specified type and size of well casing, screen and filter pack. The PBW field supervisor will measure and record the total depth of the final borehole at the completion of drilling.

The PBW field supervisor shall specify to the driller the penetration rate, depth of soil sample collection, method of sample retrieval, and any other matters which pertain to the satisfactory completion of the exploratory borings.

Soil cuttings and drilling fluid generated during drilling should be temporarily stored in steel drums or other approved containers. Final disposal of the soil cuttings and drilling fluid will be

conducted in accordance with all regulatory requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Sampling and Logging

Representative samples of cores and/or drill cuttings may be obtained and evaluated. A detailed lithologic log of these samples should be made.

Selected samples may be retained for further physical analysis. Soil samples may also be obtained for chemical analysis. Sample collection and preservation for chemical analysis will be in accordance with PBW SOP No. 5 entitled Soil and Sediment Sampling For Chemical Analysis. Selected samples that illustrate specific geologic features may be retained and shall be labeled with boring number and appropriate sample interval.

2.2.1 Obtaining Samples

When samples are collected, they should be obtained by one or both of the following methods described below.

A. Coring -- Cores will be collected from selected intervals of the exploratory borings. Core barrels, Pitcher tubes, or other split-spoon drive samplers will be used to obtain the soil cores. As appropriate, the PBW field supervisor will carefully record on a boring log information which applies to the coring, such as rate of penetration, coring smoothness, core recovery, intervals of core loss, zones of lost circulation of drilling fluid, hammer weight, drop length and blow counts, as appropriate to the drilling method.

   Cores may be retained for future examination and/or preserved for chemical or geotechnical analysis. If they are retained, the cores may be stored and labeled to show project, boring number, date, and cored interval.

B. Collecting Cuttings -- The PBW field supervisor may collect cuttings from the drilling return fluid, air return from a cyclone separator, or the auger blade for every five-foot (or more frequent) increment of the exploratory boreholes. As appropriate, sampling and logging should be performed in accordance with the following procedures (Note: Items 2 through 6 do not apply to drilling methods that do not use a drilling fluid, e.g., hollow stem auger, push point sampler, etc.):

   1. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods or augers should be taken into account in calculating the depth of penetration.

2. A small-diameter, fine-mesh hand screen or a shovel may be used to obtain a sample of the cuttings from the boring by holding the sampling device directly in the flow of the drilling return fluid or cyclone separator.

3. A sample will be obtained from the drilling return fluid or cyclone separator by leaving the sampling device in place only for the brief period required to collect an adequate sampling volume.

4. The most representative cuttings samples are usually obtained whenever the driller stops advancing the hole and circulates drilling fluid or air prior to adding another joint of drill rod.

5. Keep in mind that the deeper the hole, the longer cuttings at the drill bit take to reach the surface. The travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after fluid or air circulation is resumed. This travel time should be used along with the depth of penetration to estimate the start and finish of each sampling interval.

6. In hydraulic rotary drilling, carefully wash the cutting sample in a bucket of fresh water by slowly shaking the screen while the sample is submerged, to wash away the drilling fluid.

7. For all drilling methods, place the cutting samples on a sampling table, labeled in consecutive order. If the sample is to be retained, place the sample in a plastic or cloth sample bag labeled with the boring number and sample interval. The retained samples will later be used during preparation of a detailed lithologic log.

2.3 Logging of Boreholes

The drill-rig operator and the PBW field supervisor should discuss significant changes in material penetrated by the drill bit, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The PBW field supervisor will be present during drilling of exploratory borings and will observe and record such changes by time and depth. When using a drilling method that does not involve the use of a wet drilling fluid, the PBW field supervisor should evaluate the relative moisture content of the samples and note zones that produce water. The PBW field supervisor may record such field notes to use later in preparing a detailed lithologic log.

Core samples and selected cuttings that are collected and retained during the drilling of the exploratory borings should be examined to evaluate the lithologic properties. A detailed lithologic log for the exploratory borings should be completed using PBW's Log of Boring (Figure SOP-2-1). The lithologic description of the log may include soil or rock type, color, grain

size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information. Color may be described using the Munsell Color Chart. Soil type should be described using the Unified Soil Classification System (USCS). When the Log of Boring form is used, it should include the method of sample collection (coring, cuttings) and the sample collection interval (Figure SOP-2-1), if any samples are collected.

Field personnel may also describe soil samples according to *Standard Practice for Description and Identification of Soils, Visual-Manual Procedure, ASTM D2488*. These procedures for lithology logging may include the following:

1) Measure entire sample length and record recovery (if applicable).

2) Mark lithologic changes on Field Log of Boring form (Figure SOP-2-1).

3) Separate a small, representative portion of each distinct soil type to be identified.

4) Describe the lithology, which may include soil or rock type, grain size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information.

5) Identify the color using a Munsell color chart.

6) Identify the soil type using the field tests outlined in ASTM 2488-84.

7) Record descriptions of the soil on the Field Log of Boring form (Figure SOP-2-1). The descriptions should be in the following order:
   a) Soil color;
   b) Soil type (USCS);
   c) Moisture content;
   d) Cementation;
   e) Consistency;
   f) Angularity and shape of particles (if sand or gravel);
   g) Dilatancy/dry strength
   h) Plasticity; and
   i) Miscellaneous descriptors (roots, nodules, odors, texture percentages).

8) Dispose all remaining soil samples and cuttings in secure containers and store in an access-controlled central storage area on the Site. The containers should be properly labeled with the generation date, drilling location, and matrix.

2.4 Geophysical Logs

PBW SOP No. 4 entitled Geophysical Logging discusses in detail the steps to be followed when performing geophysical logs of exploratory borings. Geophysical logging is generally performed

in uncased, fluid-filled boreholes. Following completion of the drilling, spontaneous potential, single-point resistance, lateral resistivity, natural gamma or other logs may be made for each exploratory boring immediately after the drilling fluid has been circulated to remove all of the cuttings. When performed, geophysical logging should be done as quickly and efficiently as possible, while the wall of the borehole is in good condition, to minimize the possibility of trapping or entangling the downhole probes. Instruments on the logging unit should be adjusted to give the maximum definition of strata boundaries.

2.5 Plugging and Abandonment

For borings (pilot holes) not used to install a monitoring well and/or piezometer, the exploratory borings will be abandoned by plugging the hole with cement grout or other approved sealing agents. The PBW field supervisor shall inspect the grout for adequate mixing prior to placement in the borehole.

If the borehole is dry and is less than 10-feet deep, the grout or other approved sealant may be poured slowly from the ground surface into the borehole. The grout should be added in one continuous pour before its initial set. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout is typically placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the bottom of the bore hole and shall remain submerged in the grout during the entire grouting operation. Grout should continue to be pumped until return of fresh grout (uncontaminated by drilling fluid) is observed at the ground surface.

A typical grout mix is one (1) sack of Type I-II Portland cement, five (5) percent by weight of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite grout (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. The grout mixture may be modified to meet local regulations or site-specific conditions or specifications.

2.6 Documentation and Records Management

Field notes recorded by the PBW field supervisor during the drilling of each exploratory boring should be recorded directly on or transferred to the log form (Figure SOP-2-1). The original logs

shall be placed in the PBW project file. A copy of the logs will be retained in the field file for the project. For preparation of the report, data from the field boring logs may also be transferred to another format.

3.0 QUALITY ASSURANCE

Field notes and field forms completed by the field supervisor shall be reviewed by the task manager and the PBW Project Manager or other designated QA officer before they are placed into project files. The QA review will be recorded on the reviewed originals by initials of reviewer and date.

Figure SOP-2-1

PBW

PASTOR, BEHLING & WHEELER, LLC
2201 DOUBLE CREEK DRIVE, SUITE 4004
ROUND ROCK, TEXAS 78664
(512) 671-3434 FAX: (512) 671-3446

FIELD LOG OF BORING: (Page ___ of ___)

Location:	Logged By:
Drilling Method:	Ground Elevation:
Drilling Company & Driller Lic. No.:	Date(s):
Project No.	Sampler Type: / Drill Bit(s):

Depth	Recovery	Sample	PID (ppm-v)		Description/Remarks USCS Description, Color; Moisture Structure: stratified, laminated, fissured, slickensided, blocky, lensed, homogenous

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 3

FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during field screening of soil samples for organic vapors using portable organic vapor meters (OVMs), such as a photoionization detector (PID) or a flame ionization detector (FID). Personnel responsible for the use of these instruments must be familiar with the manufacturer's use, calibration and maintenance instructions. The procedures presented herein are intended to be general in nature and, when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Equipment List

- OVM(s) (PID and/or FID);
- OVM calibration kit (refer to instrument manufacturer's instructions; may include calibration gas, tedlar bag, regulator, connectors);
- Indelible marker (SANFORD Sharpie®, space pen, or equivalent); and
- One-quart, zip-lock plastic bags.

2.2 Operational Factors

Common OVM operational factors which may affect performance during field vapor screening may include, but are not limited to, the following:

2.2.1 PID

A. Photoionization lamp requires periodic cleaning/changing.

B. Moist atmospheric conditions (i.e., rain) and high relative humidity (>90%) in the sample or ambient air can "quench" the signal resulting in high readings. If the ambient temperature is less than the soil temperature, water vapor can condense in the PID ion chamber. Ideal conditions for conducting PID analyses are dry

weather and ambient air temperatures greater than 50 degrees Fahrenheit (10 degrees Centigrade).

C. Dust particles may absorb ultraviolet light, which reduces the energy emitted. Constituents in the dust may ionize and cause erratic responses in PID's that do not have filters. Note that the ThermoEnvironmental Instruments Models 580A and 580B do have particulate filters.

D. Sampling from a source of limited air volume will restrict the instrument air flow and provide anomalously low instrument readings.

E. Responses may be affected by interference from nearby AC or DC power lines, transformers, high voltage equipment, or radio wave transmitters.

F. The PID does not detect methane or other alkanes, thus eliminating anomalous methane contributions to total concentration readings.

2.2.2 FID

A. Low oxygen levels can influence the instrument response or cause the flame to be extinguished.

B. Recommended ambient air temperature is greater than 40 degrees Fahrenheit (4 degrees Centigrade).

C. High winds may extinguish the flame.

D. The FID requires a relatively high sample flow rate for reliable readings. Restricting the flow rate can yield inaccurate results, erratic responses, and may extinguish the flame.

E. The FID detects the total concentration of many organic vapors and gases (methane, other alkanes and aromatics). It may yield anomalously high readings (false positives) when evaluating potential hydrocarbon contamination in situations where methane is present (i.e., wetlands, sewers, septic leach fields, decaying organic matter, etc.).

F. Hydrogen gas is required for operation.

2.3 Field Operations

OVM(s) should be calibrated and operated according to the manufacturer's specifications to yield total organic vapors (TOV) in parts per million (ppm) by volume.

2.3.1 Calibration and Testing

Use ambient air (background) where "zero" air is called for in the calibration procedure. Calibration should be performed at least once at the beginning of each work day and in accordance with the instrument manufacturer's instructions.

1. If using a PID with a filter, verify that the particulate filter is properly inserted, and that the filter is not dirty or clogged.

2. Measure concentration of TOV in background air in vicinity of location where screening will be done. If ambient air was used as the "zero" air in the calibration procedure, the background concentration should be approximately zero.

3. Measure concentration of TOV within empty plastic zip-lock bags.

   A. Remove a plastic zip-lock bag at random from its packaging;

   B. Open top of bag completely;

   C. Immediately insert OVM probe to middle of bag; and

   D. Record highest reading on the appropriate Field Logs.

4. Check operation of OVM(s) by holding the tip of an indelible marker, or other organic vapor source, approximately one-half inch away from the end of the OVM probe and observing for meter deflection. Any positive deflection of OVM is indicative of proper function. Verify that OVM(s) returns to background levels. This procedure should be performed periodically during the work day. Be careful not to get ink on the OVM probe.

5. Document calibration in the Daily Field Record where indicated on the form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.3.2 Operation

1. Label each plastic zip-lock bag before the bag is used (it is much easier to write on the bag when it is empty and flat).

2. Fill bag approximately one-half full with the soil sample. Seal bag immediately under ambient conditions. Do not attempt to inflate or evacuate bag while closing. Crush the sample by squeezing sample through the bag with fingers to provide greater surface area for vapor outgassing. Agitate the sample for

approximately 15 seconds. The agitation period should be generally consistent for samples collected at the site in the same time period.

3. Allow headspace development for approximately 10 minutes at ambient air temperature. The headspace development period should be generally consistent for all samples collected from the site in the same time period.

4. Subsequent to headspace development, agitate the sample again for approximately 15 seconds. While holding top of plastic zip-lock bag, press end of OVM probe into corner of zip-lock closure and hold the remainder of zip-lock area closed around probe. Keep the end of the probe at approximately the center of the airspace within the bag. Exercise care to avoid uptake of water droplets or soil particulates into the OVM probe.

5. Record the highest reading obtained with the OVM. If using a ThermoEnvironmental Instruments Models 580A or 580B PID, the response time should be less than 2 seconds. If using different instrument(s), the manufacturer's specifications should be checked for the expected response time(s).

6. After screening each sample, verify that the OVM returns to previous background ambient air levels and/or record any changes. Record OVM measurements on a Log of Boring form (Figure SOP-2-1) or in a field notebook.

7. Discard the contents of the plastic zip-lock bag into container with other soil cuttings. Discard the zip-lock bag appropriately with other wastes.

2.4 Documentation and Record Management

Instrument calibration will be recorded with date, time and calibration results. OVM measurements for soil samples or borehole cuttings/cores will also be recorded with date, time and TOV results. This information may be included on the Daily Field Record form (Figure SOP-1-1), Log of Boring (Figure SOP-2-1) or in a field notebook.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Instrument calibration results must demonstrate that the OVM is in good working condition and can provide TOV measurements within the range expected for soils at the designated sample locations. If the instrument operation is not confirmed through the calibration and testing procedure described in Section 2.3.1 then the instrument should be tagged as "Non-Operational/Defective" and repaired or replaced immediately.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 4

GEOPHYSICAL LOGGING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for borehole geophysical logging. Borehole geophysical logs of exploratory borings may be run to aid in the interpretation and correlation of geologic units. The procedures include calibration, production, filing, and interpretation of the geophysical logs. The procedures presented herein are intended to be general in nature; when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Geophysical Well-Logging Equipment Operating Procedures

The geophysical well-logging equipment (GWLE) should be capable of performing single-point resistance, lateral resistivity, spontaneous potential, and natural gamma-ray logging as appropriate depending on project requirements.

2.1.1 GWLE Setup

The GWLE shall be arranged as follows at the borehole to be logged:

A. Place tripod over well or use pulley (sheave) suspended from drill rig.

B. Set cable reel and chart recorder sections near the borehole.

C. Attach power source (vehicle battery, generator, or line current) to GWLE.

D. Attach probe (spontaneous potential/resistance - resistivity, or gamma) to cable head.

E. Run probe and cable over tripod pulley or sheave suspended from drill rig and into the borehole.

F. Place electrical ground in mud pit or other suitable location (for spontaneous potential/resistance - resistivity logging only) in accordance with equipment specifications and project health and safety requirements.

The probe should be referenced to the ground surface elevation of the borehole by placing the probe reference mark at ground level and setting the depth counter on the cable reel section to zero.

The chart recorder section of the GWLE should be checked to determine the following:

A. Pens have sufficient ink to log the entire borehole;

B. Pen drives are working properly;

C. Chart paper is of sufficient quantity to log the entire borehole; and

D. Vertical scale is set at 1 inch = 10 feet or other suitable scale.

2.1.2 GWLE Calibration

The GWLE should be calibrated before starting both spontaneous potential/resistance - resistivity (SP/RES) and natural gamma ray (gamma) logging by following the detailed procedures in the GWLE operator manual.

2.1.3 Setting Scales

After calibration, the probe is lowered to the bottom of the borehole. While lowering the probe, the proper SP/RES or gamma scales are selected as follows:

A. SP/RES Logging:

As the probe is lowered to the bottom of the borehole, the SP and RES scales and zero adjust controls should be adjusted so that the pen has maximum deflection without going off the chart paper.

B. Gamma Logging:

1. Set time constant switch on chart recorder to 3 seconds or other suitable setting.

2. Lower the probe to bottom of borehole and observe pen deflection. Select a "recorder output" setting (gamma scale) that gives maximum pen deflection without the pen going off the chart paper (to the right).

3. The time constant switch should be adjusted to give good definition of relatively thin geologic features without showing too much "background noise".

4. Selection of a time constant and gamma scale is generally possible only while logging the borehole. After the first borehole in the drilling program has been

logged, a gamma scale and time constant may be selected for gamma logging of subsequent holes.

The scale settings and the depth at which logging will start shall be recorded on the chart paper.

2.1.4 Logging Procedure

Log the boring in accordance with the following procedure:

A. For SP/RES and gamma logging, reel the probe(s) up at an even steady rate at the speed recommended in the detailed equipment procedures. Monitor the speed by observing the instrument's rate meter.

B. Reel probe to the ground surface (which should correspond to zero on the depth counter) and record on the chart paper the actual pen position at zero depth (as indicated by the depth counter). Also record the depth of fluid in the hole, as indicated by the SP and RES curves.

The spontaneous potential/resistance - resistivity and natural gamma traces on the chart paper shall be checked in the field by the PBW field supervisor for completeness of record, and rechecked to determine if the traces are representative of assumed subsurface conditions. If the traces on the chart paper appear to be non-representative or peculiar, the instrument shall be checked for a possible malfunction and the borehole re-logged.

2.2 Documentation and Records Management

The geophysical log furnished by a geophysical logging subcontractor should include the following items below (A through R) on the subcontractor's logging form. The following data should be recorded on the logging form soon after the logs have been run:

A. Project number;

B. Date;

C. Boring description/location;

D. Log type (e.g., single-point resistance, spontaneous potential, natural gamma);

E. Scale settings;

F. Starting and completion depths of geophysical logs;

G. Datum (measuring point, MP) of logs;

H. Borehole depth and diameter;

I. Casing depth(s) and diameter(s);

J. Ground surface elevation of well (if available);

K. Type of borehole fluid;

L. Temperature of borehole fluid;

M. Level of borehole fluid (datum is measuring point);

N. Resistivity or specific conductance of borehole fluid;

O. Logging speed;

P. Vertical scale of log;

Q. Name of operator of GWLE and name of witness (if any); and

R. Pertinent remarks.

The PBW field supervisor will document the logging activities on either the Daily Field Record (Figure SOP-1-1), Log of Boring form (Figure SOP-2-1), or the Well Completion form (Figure SOP-7-1). The original geophysical log (or a reproducible copy) should be filed in the PBW project files. Copies of the logs may be retained in the field.

2.3 Interpretive Procedure

The geophysical logs may be compared to and correlated with the lithologic log of the same exploratory boring in order to evaluate the accuracy and precision of the interpretation, refine the interpretive technique, evaluate the interpretive limits of the geophysical logging procedure, and aid in identifying the hydrostratigraphic units. Geophysical logs and lithologic logs of the cored intervals of borings will be compared in order to formulate a control group to be used for correlation of uncored borings.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment

The logging probes, electrical cable and all accessories that have been in contact with the drilling fluid or have entered the borehole should be thoroughly cleaned after each trip in and out of the borehole. See PBW SOP No. 13 entitled Equipment Decontamination for additional decontamination procedures.

3.2 Technical Review

Geophysical logs, lithologic logs, and interpretive reports based on those logs should be reviewed by a geologist with experience and training in geophysics. The technical review should be performed before interpretive results are reported and record of that review should be included in the project's files along with other documentation of geophysical logging.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 5

SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocols to be followed when soil and sediment samples are collected for physical or chemical analysis. The procedures presented herein apply to: soil sampling from the surface, soil sampling when drilling boreholes, and sediment sampling from surface waters, wetlands, drainage structures, etc. These procedures are intended to be general in nature. Appropriate revisions may be made when approved by the PBW Project Manager to address site-specific conditions or project-specific protocols.

2.0 PROCEDURES

2.1 Surface Soil and Sediment Sample Collection

This section describes sampling of soils and sediment from near the land surface, including the bottom or sides of an excavation and the bottom of a surface water drainage course. The collected samples will be placed in appropriate sample containers, as designated by the laboratory, for the parameters to be analyzed.

2.1.1 Surface Soil Sampling

Soil will be removed using a spade and, if necessary, a post-hole digger to the top of the targeted sampling interval.

A. Direct Sampling Method -- A stainless-steel or, as appropriate, plastic instrument (trowel, scoop) will be used to recover the sample directly into appropriate containers provided by the analytical laboratory.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample. Extension sections may be added to reach deeper sampling intervals. This method is recommended for samples that will be analyzed for volatile organic compounds.

C. Hand Auger Method -- A hand auger with stainless-steel auger and sampler sections may be used to advance and sample the boring. Extension sections may be added to reach deeper sample intervals.

2.1.2 Sampling Sediment in a Surface Water Course

Sediment in a surface water course with little or no free water may be sampled by directly scooping the sample with a stainless steel or, as appropriate, plastic instrument (trowel, scoop). All sediments, including sediment submerged under water, may be sampled by the following methods:

A. Direct Sampling Method -- Fluid sediment may be collected directly using the sample container. If sampled under water, the container will be capped in place to avoid disturbance while surfacing.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample of the sediment. An extension section may be added to reach sediment intervals in deeper waters.

C. Remote Scoop Method -- A sampling cup or container attached to a pole may be used to collect a sediment sample in deeper water or where a longer reach is needed.

D. Bottom Sampling Dredge Method -- A sampling dredge attached to a cable also may be used to recover sediment samples in deeper waters.

2.2 Sample Collection During the Drilling of Borings

During borehole drilling, core samples may be collected for chemical analysis by lining the core barrel or drive sampler with clean brass or stainless steel liners. The procedures for obtaining soil cores are discussed in PBW SOP No. 2 entitled Supervision of Exploratory Borings. The drive sampler or core barrel will be steam cleaned or washed with a laboratory-grade detergent and water solution to remove dirt, rinsed with tap water, and then rinsed with distilled or deionized water prior to and between sampling. Upon disassembly of the soil sampler by the drilling contractor, the PBW field supervisor will take possession of the core. The core will be parted at the joints between the liners using a clean, sharp, stainless steel knife or spatula or similar implement. The most representative liner(s) in the drive sampler will be preserved for chemical analysis.

Methods for the collection and analysis of VOCs in soil or other solid matrices will be conducted to minimize volatile losses. An option for minimizing volatilization during soil sampling is to follow the general procedures detailed in the EPA Method 5035, Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples provided in the EPA SW-846, Update III dated June 1997. EPA SW-846 Method 5035 does not rigorously dictate specifics of field sample collection and laboratory sample handling protocols. The following procedures to minimize volatile losses in soil samples are suggested:

1. Samples are handled as intact soil cores in the field and laboratory.
2. Samples are stored in containers (i.e., EnCore® or similar sampling tools) which can be reliably sealed to prevent volatilization losses over the project specified analytical holding time.
3. Samples are analyzed or chemically (acid or methanol) preserved within 48 hours of collection, if any contaminant may undergo biodegradation. Longer holding times may be implemented by freezing the samples immediately after collection and during shipment to the laboratory.
4. Exposure of the sample core to the atmosphere in the field and laboratory should be minimized.

2.3 Sample Preservation

The soil or sediment sample shouldl be quickly inspected for color, appearance, and composition, then capped immediately. If brass or stainless steel liners are used, the ends of the tube will be covered with Teflon® sheeting and then capped with clean polyethylene slip caps. The capped ends will be sealed with duct tape. If samples will be placed in laboratory provided sample jars, the jar will be filled to the capacity of the jar and the lid will be securely tightened. The sample liner or jar will be placed in a plastic, ziplock bag and stored (in an ice-cooled, insulated chest, if necessary) until delivery to the laboratory.

2.4 Sample Labeling

The sample container should be labeled with self-adhesive tags. Each sample will be labeled with the following information in waterproof ink:

A. Project identification;

B. Sample identification;

C. Date and time sample was obtained;

D. Sample Depth Interval (feet below ground level); and

E. First initial and last name of sample collector(s).

2.5 Documentation and Record Management

2.5.1 Daily Field Record

A PBW field representative will document the activities of each day of field work chronologically in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation. For soil sampling, the Daily Field Record (included in PBW SOP No. 1) or field notebook entries may include the following items:

A. Decontamination Record: Decontamination method, source of tap water or deionized water, type of detergent or other cleaning agent;

B. Sample Inventory Record: Sample identification, location, date and time of sampling, sample depth interval, analyses requested and analysis methods;

C. Sampling Location Map: Surface soil sampling only, include scale, orientation, sample locations tied into a permanent reference point and sample identifications; and

D. Sampling Equipment Record: Description of sampling methodology and equipment including unique equipment identification, if available.

Copies of these records will be placed in the project files. Sample location and depth information should also be included in any electronic database maintained for the project.

2.5.2 Log of Boring Activity

As appropriate, the depth intervals of the soil samples collected for chemical analysis, the sampling date and times, and the sample identifications will be documented by the PBW field supervisor on the Log of Boring forms (included in PBW SOP No. 2 entitled Supervision of

Exploratory Borings) in the portion of the boring log corresponding to the sample interval. The original Log of Boring will be placed in the PBW project file.

2.5.3 Sample Custody

A Chain-of-Custody and Request for Analysis (CC/RA) form should be filled out for every sampling event or shipment, whichever is more frequent. Sample custody procedures and CC/RA form are discussed in PBW SOP No. 6 entitled Sample Custody, Packaging and Shipment.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

The sampler, liners, polyethylene end caps, parting knife, and any tools used in the assembly and disassembly of the sampler should be cleaned before and after each use. Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Record Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure and the other procedures referenced herein.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 6

SAMPLE CUSTODY, PACKAGING AND SHIPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) generally describes the protocol to be followed for sample custody, packaging and shipment. Appropriate revisions may be made when approved by the PBW Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier or an overnight delivery service.

2.0 PROCEDURES

The objectives of this packaging and shipping SOP are: to minimize the potential for sample breakage, leakage or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

2.1 Packaging Materials

The following is a list of materials that are typically needed to facilitate proper sample packaging:

- Chain-of-Custody Record forms (Figure SOP-6-1, or as provided by the laboratory);
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);
- Protective wrapping and packaging material; and
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice".

2.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody Record and Request for Analysis (CC/RA) form (Figure SOP-6-1 or the CC/RA form provided by the laboratory) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analyses;
9. Requested sample turnaround time;
10. Method of shipment;
11. Carrier/waybill number (if any);
12. Signature of sampling personnel;
13. Name of PBW Project Manager;
14. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred; and
15. Date and time of sample custody transfer.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another PBW employee for the purpose of transporting a sample to the designated laboratory. A sample is considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company names, and date and time of custody transfer are required. Upon transfer of custody, the PBW sampling personnel who relinquished the samples will retain a copy of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form.

2.3 Packaging and Shipping Procedure

Be sure that all sample containers are properly labeled and all samples have been logged on the CC/RA form in accordance with the procedures explained above.

All samples should be packed in the cooler so as to minimize the possibility of breakage, cross-contamination and leakage. Before placing the sample containers into the cooler, be sure to check all sample bottle caps and tighten if necessary. Bottles made of breakable material (e.g., glass) should also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Place the sample containers upright in the cooler. Avoid stacking glass sample bottles directly on top of each other.

If required by the method, samples should be preserved to 4°C prior to the analysis. Water ice or "blue ice" may be used to keep the sample temperatures at 4°C. The ice may be placed in zip-lock bags between and on top of the sample containers to maximize the contact between the containers and the bagged ice.

If there is any remaining space at the top of the cooler, packing material (e.g., styrofoam pellets or bubble wrap) should be placed to fill the balance of the cooler. After filling the cooler, close the top and shake the cooler to verify that the contents are secure. Add additional packaging material if necessary.

When transport to the laboratory by the PBW sampler is not feasible, sample shipment should occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight). In this case, place the chain-of-custody records in a zip-lock bag and place the bag on top of the contents within the cooler. Tape the cooler shut with packaging tape. Packaging tape should completely encircle the cooler.

2.4 Documentation and Records Management

The CC/RA form, Daily Field Records, or a field notebook with field notes may be kept describing the packaging procedures and the method of shipments. Copies of all chain-of-custody records and CC/RA forms (Figure SOP-6-1) will be retained in the project files. CC/RA forms provided by the laboratory will be acceptable as well.

3.0 QUALITY ASSURANCE

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-6-1. CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

PBW, LLC. COC No. _____

Round Rock Office
2201 Double Creek Drive, Suite 4004
Round Rock, TX 78664
TEL: (512) 671-3434
FAX: (512) 671-3446

PROJECT NO.: _____ PROJECT NAME: _____ PAGE: _____ OF: _____

SAMPLER (Signature): _____ PROJECT MANAGER: _____ DATE: _____

METHOD OF SHIPMENT: _____ CARRIER/WAYBILL NO.: _____ DESTINATION: _____

SAMPLES														ANALYSIS REQUEST								
		Sample Collection			Preservation					Containers				Constituents/Methods					Handling			Remarks
Lab No.	Field Sample Identification	DATE	TIME	Matrix*	HCl	HNO_3	H_2SO_4	COLD	FILTRATION*	VOLUME (ml/oz)	TYPE*	NO.							HOLD	RUSH	STANDARD	

TOTAL NUMBER OF CONTAINERS

LABORATORY COMMENTS/CONDITION OF SAMPLES

Cooler Temp:

RELINQUISHED BY:			DATE	TIME	RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY			SIGNATURE	PRINTED NAME	COMPANY
							LABORATORY

*KEY: Matrix: AQ - aqueous NA - nonaqueous SO - soil SL - sludge P - petroleum A - air OT - other Containers: P - plastic G - glass T - teflon B - brass OT - other Filtration: F - filtered U - unfiltered

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

Pastor, Behling & Wheeler,

STANDARD OPERATING PROCEDURE No. 7

INSTALLATION OF MONITORING WELLS AND PIEZOMETERS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during installation of monitoring wells and piezometers by PBW. The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Monitoring Well Installation

Each monitoring well will be designed to register the potentiometric surface and to permit water sampling of a specific depth zone encountered beneath the drill site. Separate monitoring wells may be completed, as necessary, in the different water-yielding zones underlying the site. The PBW field supervisor, in consultation with the PBW Project Manager as needed, will specify the exact depths of screened intervals using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the exploratory borings for the monitoring wells will be conducted in accordance with PBW SOP No. 2 entitled Supervision of Exploratory Borings. Construction and completion of all monitoring wells will be in general conformance with the following procedures. Specific monitoring well completion requirements may vary in accordance with project-specific work plans and/or local regulatory agency guidance.

2.1.1 Screens and Riser Casing

The monitoring well assembly shall consist of flush joint, threaded casing composed of mild steel, stainless steel or polyvinyl chloride (PVC) Schedule 40 (minimum). The threaded joints will have O-ring seals. Steel casing joints may be welded rather than threaded. The inside diameter of both the perforated and unperforated casing will be sufficiently large to permit easy passage of an appropriate water-level probe, equipment for development and purging of wells, and for collection of groundwater samples.

The perforated casing (well screen) will be factory slotted. The perforations will be compatible in size with the selected filter material. These perforated casing sections are generally not intended to provide optimum flow but only to provide hydraulic connection between the pervious material in the water-yielding zone and the monitoring well.

Prior to well construction, the PBW field supervisor will inspect the blank and perforated casing delivered to the job site to verify that it meets the project specifications.

When the total depth of a boring has been reached, and prior to installation of the well casing, the PBW field supervisor will measure and record the depth to water in the borehole.

Upon completion of drilling and/or geophysical logging, the monitoring well casing and screen will be assembled and lowered to the bottom of the boring. The monitoring well assembly will be designed so that the well screen is approximately adjacent to the water-yielding zone that is to be monitored. The bottom of the screen will be approximately flush with the bottom of the well and will be closed with a threaded PVC cap or plug, or a slip cap secured with stainless steel screws. No PVC cement or other solvents are permitted to be used to fasten the joints of the casing or screen. Centralizers spaced at the top and bottom of the screened interval and not more than 40 feet apart along the casing may be used to center the well assembly in the borehole, unless the boring is drilled by a low annular space method and the well is installed with the drill casing in place. Wells installed prior to pulling low annular space drill casing will be centered by the inside walls of the drill casing.

If well casing assembly is being performed by a drilling subcontractor, the PBW field supervisor will observe and inspect the assembly, insuring that the bottom cap is threaded or secured with stainless steel screws, O-rings are properly placed in the joints, the joints are completely tightened, and the blank and perforated intervals are constructed as specified. The PBW field supervisor will measure the location of the top and bottom of the perforated interval by measuring the distances from the joint above the perforated interval to the top slot and from the base of the bottom cap to the bottom slot.

When using the mud rotary drilling technique, after the monitoring well assembly has been lowered to the specified depth, clean water may be circulated downward through the well casing and upward through the annular space between the borehole wall and the monitoring well casing. Circulation will continue until the suspended sediment in the return fluid has been thinned.

If the well is greater than 50 feet deep, the casing assembly will be held under tension prior to and during emplacement of the filter pack and seal.

2.1.2 Filter Material

Filter material will be a well-graded, clean sand with less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material.

Filter sand will be placed in the annular space using a one-inch diameter (or larger) pipe, in a calculated quantity sufficient to fill the annular space to a level of about two feet above the top of the perforated casing. The required height of the filter pack above the top of the perforated casing may vary by jurisdiction. The depth to the top of the filter pack should be verified by measuring, using the tremie pipe or a weighted steel tape. When use of a tremie pipe is not feasible, the filter sand may be poured slowly between the well casing and the inside walls of the auger, and the drill casing may be removed in stages.

2.1.3 Seal

Once the depth to the top of the filter pack has been verified, a layer of bentonite pellets or chips will be emplaced by pouring the pellets into the annular space in a calculated quantity sufficient to fill the annular space to a level at least one foot above the top of the filter pack. The depth to the top of the bentonite pellets/chips layer should be verified by measuring, using the tremie pipe or a weighted steel tape. When the bentonite pellets/chips are placed above the zone of saturation, they should be hydrated, after they have been emplaced, by adding clean, potable water. Approximately 1 gallon of water should be added for every foot of bentonite pellets/chips, which should be slowly poured into the borehole annualus to hydrate the pellets/chips. More water may be required when completing a well in relatively permeable material. The bentonite pellets/chips should be hydrated in lifts no greater than 3 feet.

A bentonite/cement grout seal or other approved sealant should be emplaced above the bentonite pellet layer after it has been allowed to hydrate for a minimum of ½ hour. If the depth to the top of the bentonite pellet layer is dry and is less than approximately 10 feet deep, the grout may be poured slowly from the ground surface into the annular space. The grout should be added in one continuous pour before its initial set. If the depth is greater than approximately 10 feet deep, or if

more than two feet of water is present in the annular space, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the top of the bentonite seal and shall remain submerged in the grout during the entire grouting operation. When constructing a well or piezometer inside a low annular space drill casing, the drill casing may be used as a tremie pipe by pouring the grout down the annular space between the well casing and the inner wall of the drill casing. Grout should continue to be pumped until return of fresh grout is observed at the ground surface.

The bentonite/cement grout mix should generally consist of one (1) sack of Type I-II Portland cement, five (5) percent by weight (of cement) of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. An alternative grout mixture may be used if approved by the applicable regulatory agency and the PBW Project Manager. Only clean water from a potable supply will be used to prepare the grout. The grout seal will extend from the top of the bentonite seal to near the ground surface. After grouting, no work will be done on the monitoring well until the grout has set for a minimum of 24 hours.

When the casing hammer air rotary or similar method is used to complete the borehole for a monitoring well, the protective casing will be jacked out of the borehole gradually as the filter pack, bentonite seal, and cementing operations are in progress.

2.1.4 Capping Monitoring Well

Upon completion of the work, a suitable watertight, cap or plug will be fitted on the top of the well casing to prevent the entry of surface runoff or foreign matter. The well will be completed either: (1) above the ground surface using a locking, steel protective well cover set in concrete; or (2) below the ground surface using a watertight, traffic-rated valve-box with a bolt-down cover.

2.2 Piezometer Installation

The piezometer should be designed to register the potentiometric surface of a specific depth zone encountered beneath the drill site. The PBW field supervisor, in consultation with the PBW Project Manager, will specify the exact depths of the piezometers using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the boreholes for the piezometers will be in conformance with PBW SOP No. 2 entitled SUPERVISION OF

EXPLORATORY BORINGS. Construction, completion and development of the piezometers will generally follow the same procedures as those for monitoring wells (see Section 2.0 above), except that a piezometer may be completed with casing material of less than two inches in diameter and may use a porous tip (ceramic or other material) in place of perforated casing.

2.3 Documentation and Records Management

The PBW field supervisor will complete a Well Construction Summary form for each monitoring well (Figure SOP-7-1). The completed form should be included in the project files. In addition to the information requested on the Well Construction Summary form, the PBW field supervisor should record the volumes and types of well construction materials (filter material, bentonite, cement, etc.) used for each well in their field notes. Also, the daily events and other items not covered in the Well Construction Summary form will be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment Used in Drilling, Well Construction

The drilling equipment will be thoroughly steam cleaned before and after installation of each monitoring well or piezometer. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement the steam cleaning if tarry or oily deposits are encountered. Equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

Well casing that is not factory cleaned and in a sealed container be steam cleaned thoroughly before it is installed. After cleaning, the casing will be covered with plastic to protect it from contact with dust or other contaminants.

Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with municipal water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-7-1. WELL CONSTRUCTION SUMMARY FORM

Well Completion

WELL CONSTRUCTION SUMMARY

Well (number, ID, etc.) _____

Project: _____ Location: _____

Staff: Supervisor:

Elevation: Ground Level _____

Top of Casing:

DRILLING SUMMARY

Total Depth: _____ Borehole Dia.: _____

Driller: _____ Driller's Number: _____

Rig: _____ Bit(s): _____

Drilling Company: _____

Drilling Fluid:

CONSTRUCTION TIME LOG

TASK	START		FINISH	
Drilling:				
Geoph. Logging:				
Casing:				
Filter Placement:				
Bentonite Seal:				
Grout:				
Development:				
Other:				
Surface Comp.:				

WELL DESIGN:

Basis: Geologic Log _____ Geophysical Log _____

Casing String(s): C= CASING S= SCREEN

_____	- _____	_____	_____	- _____	_____
_____	- _____	_____	_____	- _____	_____
_____	- _____	_____	_____	- _____	_____
_____	- _____	_____	_____	- _____	_____
_____	- _____	_____	_____	- _____	_____

CASING: C1 _____

C2 _____

C3 _____

C4 _____

SCREEN: S1 _____

S2 _____

CENTRALIZERS: _____

FILTER MATERIAL: _____

BENTONITE SEAL: _____

CEMENT: _____

OTHER: _____

DECONTAMINATION: _____

COMMENTS: _____

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STANDARD OPERATING PROCEDURE No. 8

MONITORING WELL DEVELOPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during the development of groundwater monitoring wells. Monitoring wells must be developed before they are used to collect groundwater samples. The procedures presented are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Development Procedure

After construction of the monitoring well is complete, the well may be developed by surging, bailing and/or pumping (e.g., positive displacement hand pump, electric pump or pneumatic pump). Typically, at least 24 hours should pass between completion of grouting of the monitoring well and development to allow sufficient curing of the grout.

The total depth of the well should be measured in accordance with the procedures described in PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement. The presence of sediment at the bottom of the well may be checked using a stainless steel bailer or positive displacement hand pump. Water and sediment should first be removed from the bottom of the well to ensure that the entire screened interval is open for water to flow into the well. The well should be bailed or pumped until the water removed from the bottom of the well is relatively free of sediment. If a bailer is used, care must be taken to avoid breaking the bottom cap on the well casing.

After most of the sediment has been removed from the bottom of the well, a well development pump (positive displacement hand pump, electric pump or pneumatic pump) may be used to remove water from the well. Initially, the intake of the pump should be at the bottom of the well. The pump intake should be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

Next, a surge block constructed of non-reactive material (usually stainless steel or PVC) may be used to develop the well screen by forcing water in and out of the screened area. The surge block should be moved up and down in one-to two-foot increments creating a suction action on the upstroke and a pressure action on the downstroke. Development should begin at the top of the water column and move progressively downward to prevent the surge block from becoming sand locked. After surging to the bottom of the well, the surge block should be moved progressively upward to the top of the water column.

If necessary, water may be added to the well to facilitate surging. This water should be distilled deionized or "clean" potable water. The volume of de-ionized water added to the well should be noted on the Well Development Record form (Figure SOP-8-1).

After surging, the surge block should be removed and replaced with the pump or bailer. The intake of the pump or bailer should be at the bottom of the well to remove any sediment that may have collected in the bottom of the well. The pump intake should again be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

During development, the pH, specific conductance and temperature of the purge water may be periodically measured and documented on a Well Development Record form. Parameter readings should be collected and noted for every casing volume of water removed from the well.

The well may be alternately surged and pumped until the field water quality parameters have stabilized to within 10% for specific conductance, 0.05 pH units for pH, and 1EC for temperature, and the water is relatively clear and free of sediment.

Water removed during well development should be temporarily stored in steel drums, a portable storage tank or other approved storage container. Final disposal of all water generated during development procedures will be conducted in accordance with all legal requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Documentation and Records Management

A Well Development Record should be filled out by the PBW Field Supervisor for each well developed. Also, the daily events and other items not covered in the Well Development Record

should be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

All reusable equipment used in developing the monitoring well should be cleaned prior to and following use. Cleaning should be accomplished by either (1) washing with a laboratory-grade detergent/water solution, rinsing with clean, potable water, then rinsing with distilled or deionized water; or (2) steam cleaning followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water. After final cleaning, equipment should be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminant when not in use.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-8-1. WELL DEVELOPMENT RECORD

WELL DEVELOPMENT RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Well Location (well ID, etc.):

Developed by:

Measuring Point (MP) of Well:

Screened Interval (ft. BGL):

Filter Pack Interval (ft. BGL):

Starting Water Level (ft. BMP): _____

Casing Stickup (ft.): _____

Starting Water Level (ft. BGL): _____

Total Depth (ft. BGL): _____

Casing Diameter (In ID): _____

Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Purging: _____ Surge Equipment: _____

Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Other:

DEVELOPMENT MEASUREMENTS

Time	Flow		Water Quality			Appearance		Remarks
	Cum. Vol. (gal. / L)	Purge Rate (gal. / L pm)	Temp. (°C)	pH	Spec. Cond. (µmhos/cm)	Color	Turbidity & Sediment	

Total Discharge (gallons):

Observations/Comments:

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STANDARD OPERATING PROCEDURE No. 9

WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT

1.0 SCOPE AND APPLICABILTIY

This Standard Operating Procedure (SOP) describes the protocol to be followed during measurement of water levels, immiscible layer and well depths in monitoring wells and piezometers. As the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

Before measuring fluid levels, the construction details and previous measurements for each well or piezometer shall be reviewed by the PBW field supervisor so any anomalous measurements may be identified. Well construction details and previous measurements shall be available in the field for review.

In general, fluid-level measurements shall be performed before groundwater is removed from the well by purging or sampling.

2.1 Equipment

Equipment that may be necessary to perform measurements includes:

- Well/piezometer construction details;
- Interface probe; and
- Fluid- Level Monitoring Record Sheet (From SOP 9-1);

2.2 Measuring Point

A measuring point (MP) shall be selected and marked for each monitoring well and piezometer in which water level measurements will be made. Generally, the MP will be the top of the well casing on the north side. The MP will be permanently marked using an indelible marker or a notch cut into the PVC casing. When the top-of-casing elevation of a monitoring well or piezometer is surveyed, the licensed surveyor should measure the MP elevation and reference this measurement to an appropriate datum (such as feet above mean sea level).

2.3 Fluid-Level Measurements

Fluid levels in all wells will be measured with an interface probe because of the presence or potential presence of non-aqueous phase liquid (NAPL) in the well. All fluid level measurements will be recorded to the nearest hundredth of one foot. Note the instrument used for each measurement on the Fluid Level Monitoring Record (Figure SOP-9-1).

The procedure for measuring water levels with an electric probe is as follows:

1. Switch on.
2. Lower the electric cable into the well until the ammeter or buzzer indicates a closed circuit. An intermittent beep indicates the presence of a light NAPL (LNAPL) or phase-separated hydrocarbons (PSH). A continuous beep indicates water.
3. With the cable in this fixed position, note the depth to the LNAPL (if encountered) and water from the Measuring Point (MP).
4. As necessary, check the total depth of the well below the MP using the interface probe by slowly lowering the probe to the bottom of the well and noting the depth.
5. If dense NAPL (DNAPL) is suspected to be present in the well, measure the bottom of the well with the interface probe in the "on" position and note if there is a change in the probe tone or blinking light..
6. If NAPL is not encountered, put an "NP" in the PSH column to indicate that NAPL (both LNAPL and DNAPL) was not present in the well.

Record the NAPL or PSH thickness in the "PSH Thickness" column of the Fluid Level Monitoring Record (Figure SOP-9-1). If LNAPL is not detected using the interface

probe, but the presence of LNAPL is suspected, the presence of a very thin layer or sheen (too thin to be measured) may also be checked using a bottom-filling transparent bailer. The presence of a thin LNAPL layer is checked by lowering the bailer into the well. Care must be taken to not completely submerge the bailer. Retrieve the bailer and visually examine the air/liquid interface for the presence of an immiscible light-phase layer or sheen. Note that the transparent bailer is not to be used to measure the thickness of LNAPL in a well.

3.0 DOCUMENTATION AND RECORDS MANAGEMENT

Fluid levels observed in wells selected for the groundwater monitoring network should be tabulated on a Fluid Level Monitoring Record form during each monitoring period (Figure SOP-9-1). The date and time of each measurement should also be recorded on the Fluid Level Monitoring Record. All fluid-level measurements should be recorded to the nearest 0.01 feet.

Fluid-level data should be recorded as feet below measuring point so that water level elevations should calculated from the depth-to-water measurement (from measuring point) and the surveyed elevation of the measuring point at each well or piezometer.

If LNAPL is encountered during water level measurement, the measured thickness or observation shall be recorded in the "Depth to Product" column. Each form or, as appropriate, individual measurement data, should be signed to indicate the originator.

4.0 QUALITY CONTROL

4.1 Equipment Decontamination/Cleaning

The interface probe should be cleaned before and after each measurement. Cleaning should be accomplished by washing with a laboratory-grade detergent/water solution, rinsing with clean, potable, water, wiping or spraying with isopropyl alcohol (if needed), then rinsing with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

4.2 Technical and Records Reviews

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

In addition, all calculations of water-level elevations and NAPL correction to water-level elevations (if necessary) should be reviewed before they are submitted to the project file and used to describe site conditions. Technical personnel familiar with this procedure should perform the calculation review. Evidence of the completed review and any necessary corrections to calculations should also be included in the project file.

FIGURE SOP-9-1. FLUID LEVEL MONITORING RECORD

FLUID LEVEL MONITORING RECORD		DATE:
Project No.	Project Name:	PAGE _____ of _____
Weather Conditions:		
Measuring Device:	Datum (MSL, NGVD, etc.):	
Observations/Comments:		

Well ID	Time	MP Elevation (ft.)	Depth to Product (ft. BMP)	Depth to Water (ft. BMP)	PSH Thickness (ft.)	Total Depth (ft. BMP)	Water Elevation (ft)	Remarks

Measured By:	**Pastor, Behling & Wheeler, LLC**
Checked By:	**2201 Double Creek Drive, Suite 4004**
	Round Rock Texas
	Phone: (512) 671-3434 Fax: (512) 671-3446

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 10

WATER QUALITY SAMPLING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of groundwater. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when they are approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Groundwater Sample Collection

Individual samples from wells should be collected as follows:

A. The depth to water and the thickness or presence of a Non-Aqueous Phase Liquid (NAPL) in a well should be measured using the procedures discussed in the PBW SOP No. 9 (Water Level, Immiscible Layer and Well Depth Measurement).

B. As appropriate based on project requirements, a low-flow purge method or "micopurge" method should be used for sample collection. Wells should be purged at a low pumping rate to minimize agitation of water in the well and minimize drawdown. The goal is to limit drawdown in the well to less than 10 percent of the length of the saturated well screen. If the initial water level is above the top of the screen, then the goal is to limit drawdown due to purging so that the water level in the well does not drop below the top of the screened interval. Wells should be purged by pumping water at a rate less than 1 L per minute using a peristaltic pump. Bailers will not be used for purging of sampling wells. If during low-flow sampling the turbidity remains greater than 10 NTUs, the discharge from the pump will be filtered with an in-line 10 μm filter during sample collection. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled.

C. At each well, the sample should be collected through a section of new, clean, flexible tubing.

D. For sampling active hydrocarbon recovery systems, the recovery pumps should be pulled from the well before sampling.

E. The sampling intake should be placed near the center of the well's screened interval or deeper if this reduces the chance of pumping LNAPL while purging the well.

F. Prior to collecting samples from a well, a clean plastic apron may be placed adjacent to or around the well to prevent equipment and sample containers from coming into contact with surface materials. Alternatively, a clean field table may be set up near the well. If used, the table will be cleaned before and after use at each well.

G. Sample containers prepared specifically for the required analyses by the analytical laboratory or their supplier should be used for sample collection. Glass sample bottles for non-volatile analyses should be filled to near the top. To account for slight expansion due to temperature changes, leave headspace approximately equivalent to the volume of liquid that would fill the bottle's cap. Plastic sample bottles should be filled completely. Splashing of the water in the sample container and exposure to the atmosphere should be minimized during sampling. The container cap should be screwed on tightly immediately after filling the sample container.

   Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling.

H. Where more than one well within a specific field or site is to be sampled, the sampling sequence should begin with the well having the lowest suspected level of contamination. Successive samples should be obtained from wells with increasing suspected contamination. If the relative degree of suspected contamination at each well cannot be reasonably assumed, sampling should proceed from the perimeter of the site towards the center of the site. The sampling sequence should be arranged such that wells are sampled in order of increasing proximity to the suspected source of contamination, starting from the wells up-gradient of the suspected source.

I. Sampling activity for each monitoring well should be recorded on a Groundwater Sampling Record (Figure SOP-10-1).

2.2 Sample Filtration

When a filtered surface water sample is required, a sample should be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of polyvinylchloride tubing or other appropriate method. An aliquot of approximately 200 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

2.3 Sample Containers and Volumes

Sample containers and volumes should be selected based on the target analytical suite for each sample.

2.4 Sample Labeling

Sample containers will be labeled with self-adhesive tags. Each sample will be labeled with the following information using waterproof ink.

A. Project identification;

B. Sample identification;

C. Date and time samples were obtained;

D. Requested analyses and method;

E. Treatment (preservative added, filtered, etc.); and

F. Initials of sample collector(s).

2.5 Sample Preservation and Storage

As required based on the target analytes, water samples submitted for chemical analysis should be stored at 4° C in ice-cooled, insulated containers immediately after collection. The samples may be delivered to the laboratory soon after they are collected, in which case the water samples may not have had sufficient time to cool to 4° C. In these

instances, the samples will be considered properly preserved as long as they were placed on ice immediately after they were collected.

2.6 Sample Custody

Samples should be handled and transported according to the sample custody procedures discussed in PBW SOP No. 6 entitled Sample Custody, Packaging, and Shipment. The sample collector shall document each sample on the Chain-of-Custody and Request for Analysis form (Figure SOP-6-1).

2.7 Field Measurements

Specific conductance, pH, temperature and turbidity measurements may be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be reopened).

For groundwater samples, at least three field measurements should be taken during the course of micro-purging the well. If the parameters have not stabilized at that time, field measurements and purging will continue until two consecutive readings have stabilized to within the following limits:

- Temperature: +/-1° C
- pH: +/-0.1 pH units
- Specific conductance: +/-10%
- Turbidity: +/- 10%

The procedures for collecting the listed field parameters are discussed in the following sections.

2.7.1 Temperature Measurement

Temperature should be measured directly from the water source or from a separate sample aliquot. Temperature measurements should be made with a mercury-filled thermometer, bimetallic-element thermometer or electronic thermistor (usually included with the pH and/or conductivity meter). Measurements should be recorded in degrees Celsius (°C).

2.7.2 pH Measurement

A pH measurement should be made by dipping the probe directly into the water source or into a separate sample aliquot. The preferable method is to collect measurements through a flow-thru cell. Prior to measurement, the container in which the field parameter sample will be collected should be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water removed from a well during the purging process. The pH measurement should be made within a few minutes after collection of the field parameter sample using a pH electrode. The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter should be recalibrated using the appropriate buffer solutions.

2.7.3 Specific Conductance Measurement

Specific conductance should be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance is reported in micromhos/cm at 25° C.

The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting should be changed to a position that gives maximum definition. If the specific conductance value falls outside of the calibrated range of the

conductivity standard solution, then the instrument should be recalibrated using the appropriate standard prior to measurement.

2.7.4 Turbidity

The turbidity meter will be operated according to the manufacturer's instructions. Turbidity measurements are taken in nephelometric turbidity units (NTUs), which are generally read to the nearest 0.1 NTUs, if possible. When using a turbidimeter, make sure the glass sample vial is very clean, does not have condensation on it, and that there are few, if any, air bubbles present in the sample. These factors can all interfere with turbidity readings. In addition, if soluble compounds in the sample begin to precipitate out of solution (e.g., dissolved iron or manganese), then the turbidity measurements may be artificially high. If a turbidimeter is not available, turbidity can be measured qualitatively by indicating whether the sample has very little turbidity, moderate turbidity or is very turbid, or by a similar descriptive method. Keep in mind that this is a subjective and qualitative way to measure turbidity.

2.7.5 Equipment Calibration

Equipment used to measure field parameters should be calibrated by PBW personnel according to manufacturer's instructions. Calibration checks should be performed at least once prior to and at least once following each day of instrument use in the field and the results should be documented on the Sampling Record for each sampling station.

3.0 DOCUMENTATION

When the sampling activity is completed, the sampling records (Groundwater Sampling Record (Figure SOP-10-1) or Surface Water Sampling Record (Figure SOP-10-2)) should be checked by the PBW Project Manager or his/her designee, and the original record placed in the PBW project file. The following sections discuss the information that should be documented during groundwater or surface water sampling activities.

3.1 Groundwater Sampling Record

Each sampling event for each monitoring well will be recorded on a separate Groundwater Sampling Record form (Figure SOP-10-1). The documentation should include the following:

A. Project identification;

B. Location identification;

C. Sample identification(s) (including quality control samples);

D. Date and time of sampling;

E. Purging and sampling methods;

F. Sampling depth;

G. Name(s) of sample collector(s);

H. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

I. Total volume of water purged;

J. Results of field measurements and observations (time and cumulative purge volume, temperature, pH, specific conductance, turbidity, sediment, color, purge rate);

K. Equipment cleaning record;

L. Description and identification of field instruments and equipment; and

M. Equipment calibration record.

3.2 Surface Water Sampling Record

Activities for each surface water sample collected will be recorded on a separate Surface Water Sampling Record form (Figure SOP-10-2). The documentation should include the following:

A. Project identification;

B. Name(s) of sample collector(s);

C. Weather conditions (current and previous 48 hours);

D. Location identification and type of water body;

E. Sample identification(s) (including quality control samples);

F. Date and time of sampling;

G. Sampling methods;

H. Size, configuration of the water body sampled;

I. Flow estimates, if necessary;

J. Sampling depth, depth of water body;

K. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, suspended sediment, color; conductivity/salinity, etc.);

L. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

M. Total volume of water purged;

N. Equipment cleaning record;

O. Description and identification of field instruments and equipment; and

P. Equipment calibration record.

4.0 QUALITY CONTROL

4.1 Chain-of-Custody and Request for Analysis Form

A Chain-of-Custody and Request for Analysis form (CC/RA form) should be filled out as described in PBW SOP No. 6.

4.2 Equipment Cleaning

Sample bottles and bottle caps should be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and

bottle caps will be protected from dust or other contamination between time of receipt by PBW and time of actual usage at the sampling site.

4.3 Records Review

The PBW Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-10-1. GROUNDWATER SAMPLING RECORD

GROUNDWATER SAMPLING RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Sample Number: Starting Water Level (ft. BMP):

Sampling Location (well ID, etc.): Casing Stickup (ft.):

Sampled by: Starting Water Level (ft. BGL):

Measuring Point (MP) of Well: Total Depth (ft. BGL):

Screened Interval (ft. BGL): Casing Diameter (In ID):

Filter Pack Interval (ft. BGL): Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment:

Purging: Sampling:

Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: Thermometer:

pH Meter: Field Calibration:

Conductivity Meter: Field Calibration:

Filter / Filter Size: Other:

SAMPLING MEASUREMENTS

Time	Cum. Vol. (gal. or L)	Purge Rate (gal. or L /m)	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O.	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)

Water Level (ft. BMP) at End of Purge: Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration	Preservation	Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)		(quality control sample, other)

Comments:

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Round Rock, TX 78664
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FIGURE SOP-10-2. SURFACE WATER SAMPLING FORM

SURFACE WATER SAMPLING RECORD

SAMPLE NUMBER:

Project No:_____ Project Name:_____ Page _____ of: _____

Sampled by _____ Date: _____

Weather (@ sampling): _____ Weather (past 48 hrs.) _____

Sampling Location (i.d., description): _____

Water Body (describe type, flow):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Sampling:_____

INSTRUMENTS (indicate make, model, i.d.):

Flow Measurement: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Filtration: Other:

SAMPLING MEASUREMENTS

Time	Sampling Depth (ft.)	Water Quality Data				Appearance		Remarks (debris, sheen, etc.)
		Temp. (°C)	pH	Specific Conductance (µmhos/cm)		Color	Turbidity & Sediment	
				@ Field Temp.	@ 25° C.			

Flow @ Sampling Point (units): Total Depth @ Sampling Point (Ft.):

SAMPLE INVENTORY

Bottles Collected				Filtration (Y/N)	Preservation (type)	Remarks (quality control sample, other)
Time	Volume	Composition (glass, plastic)	Quantity			

SAMPLING LOCATION MAP

(ref. permanent landmarks, indicate scale, approx. North, flow)

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STANDARD OPERATING PROCEDURE No. 11

FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of oxidation-reduction potential in water samples. If necessary to accommodate specific field conditions, modifications of these procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Method

The potential difference measured between an indicator electrode and a reference electrode in a water sample is the oxidation-reduction potential (ORP) of the water. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode.

The oxidation-reduction potential of water samples is most commonly reported relative to the standard hydrogen electrode, as Eh. Therefore, the oxidation-reduction potential of a water sample measured using a platinum indicator electrode and reference electrode must be corrected for the half-cell potential of the reference electrode in order to provide an Eh estimate for the water.

2.2 Instrumentation and Equipment

Typically, measurement of ORP requires the following equipment:

1. pH meter reading millivolts **OR** ORP meter such as Orion Model 98-75

2. Combination ORP electrode (Pt electrode with reference electrode) **OR** Reference electrode[1] (calomel or Ag/AgCl) and platinum electrode

3. Reference electrode filling solution, as required for some combination ORP electrodes[2]

4. Calibration standard (Zobell or Light's solution)

5. Clean (e.g., deionized) water for probe cleaning

6. Squeeze bottle for clean water

7. Clean container for sample water during measurement

8. Electrode cleaning solution

2.3 Instrument Checks

It is not possible to calibrate ORP electrodes over a range of conditions. Instead, standard solutions of known redox potential for specific indicator electrodes (i.e., Pt electrode) are used to check the electrode response at the temperature of measurement. Calibration checks should be performed and recorded on the Eh Data Sheet (Figure SOP-11-1) prior to each sample measurement as follows:

1. Assemble meter with either combination ORP electrode or set of platinum and reference electrodes.

2. If needed, select appropriate filling solution and fill reference electrode with fresh solution.

3. Place standard solution in clean container.

4. Measure and record temperature of standard solution (T_1) in degrees C.

5. For Zobell's solution, calculate the theoretical potential at the measured temperature using the following equation:

$$Eh_{(Zobell)} = 428 + 2.2*(25 - T) = \_\_\_\_\_ mV$$

---

1 The reference electrode and the filling solution must be recorded with ORP measurements.

2 If a combination ORP electrode is used, it may be possible to select the appropriate electrolyte filling solution for the reference electrode. For sample waters of low ionic strength (< 10,000 mg/L TDS), use the filling solution that matches the potential of a calomel electrode. For higher ionic strength waters (> 10,000 mg/L TDS), use 4N KCl saturated with Ag/AgCl.

6. For Light's solution, the theoretical potential at 25°C is **675 mV**. *(note: no temperature correction data available for Light's solution)*

7. Measure and record the potential of the standard solution in mV.

8. Correct the measured potential of Zobell's solution for the half-cell potential of the reference electrode using the potential of the reference electrode for the temperature of measurement (T_1) given in Table 1 below.

$$Eh_{(Standard)} = E_{(Standard),\ observed} + E_{(ref.\ electrode),\ at\ T_1} = \_\_\_\_\_ mV$$

Table 1. Half-Cell Potential of Reference Electrode at T

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251 mV	214 mV
20	244 mV	204 mV
25	241 mV	199 mV
30	238 mV	194 mV

9. Compare the corrected, measured potential of the standard solution (step 8) to the theoretical potential at the measured temperature (calculated in step 5 or 6). If the values are more than ±10 mV different, the meter and electrode functions should be checked as follows:

   (a) recheck temperature of standard solution
   (b) replace electrode filling solution
   (c) clean electrodes (refer to Section 4.1)
   (d) replace standard with new mix of solution

   Note: If the temperature of the standard solution is much higher or lower than 25°C (i.e., ± 15 degrees C), then the half-cell potential of the reference electrode may deviate significantly from the values given in Table 1. In this case, the proper function of the ORP measurement system cannot be verified.

   Alternate procedures are available to check the function of the ORP measurement system but require two reference electrodes, one that is known to be functioning properly. Refer to APHA Method 4500-H, Section 5.b. for a description of the alternate procedures.

10. Check initial measurement of standard solution. Measurements should agree within 10 mV. If the measurements do not agree, the meter and electrode functions should be checked as described in step 9.

2.4 Sample Measurement

After measurement of the standard solution confirms the electrode function, measure the redox potential of the water sample as follows:

1. Thoroughly clean the outside of the electrode(s) with deionized water prior to introducing to the sample water.

2. Measure and record sample temperature (T_2) in degrees C.

   Note: If the sample temperature is more than approximately 10 degrees C higher or lower than the temperature of the standard solution previously measured, the sample measurement may require additional time to stabilize due to drift in the reference electrode potential. Efforts should be made to maintain the standard solution at approximately the same temperature as the sample waters to be measured.

3. Immerse the ORP electrode(s) in the sample water.

4. Wait 2 minutes and then record the measured potential in mV.

5. Correct the measured potential of the sample solution for the half-cell potential of the reference electrode at the temperature of measurement (T_2) (refer to Table 1):

$$Eh_{(Sample)} = E_{(Sample),\ observed} + Eh_{(ref.\ electrode),\ at\ T_2} = \_\_\_\_\_\ mV$$

These steps must be documented on the attached Eh Data Sheet for each sample measurement.

2.5 Documentation and Record Management

Calibration information should be recorded on the Eh Data Sheet. ORP measurements will also be recorded on the Eh Data Sheet (Data Record, page 2 of 2) with associated calculations to compute Eh from ORP measurements. ORP measurements should not be reported as Eh data without first performing the correction calculations.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Electrode Maintenance and Storage

Contamination of the electrode surface, salt bridge, or internal electrolyte solution in the case of reference electrodes can lead to excessive drift, poor electrode response, and artifact potentials (electrode "poisoning").

3.2 Routine Maintenance for Intermittent Use

The reference electrode should be cleaned for storage following each series of measurements or daily, as follows:

> Empty reference electrode of filling solution and rinse thoroughly with distilled water. The electrode should be stored filled with distilled water and should be labeled as so. If salt deposits have formed on the outside of the electrode casing, clean with a dilute acid or detergent solution and rinse thoroughly with distilled water.

The Pt indicator electrode should be cleaned daily by rinsing with distilled water and should be stored in distilled water between uses.

3.3 Long-term Maintenance

Follow manufacturer's instructions for long-term maintenance, cleaning and rejuvenation of electrodes. If excessive drift occurs or erratic performance of electrodes is observed in a standard solution after appropriate cleaning, refilling or regeneration procedures, discard the faulty electrode and use a new one.

3.4 Records Review

Calculations should be checked before any ORP or Eh data are reported for use on a project. The calculation check should be documented by the reviewer's initials and date of review on the Eh Data Sheet.

4.0 REFERENCES

American Public Health Association (APHA), 1995. *Standard Methods for the Examination of Water and Wastewater, 19th Edition.* Published by APHA, American Water Works Association, and Water Environment Association.

American Society for Testing and Materials (ASTM), 1993. *Standard Practice for Oxidation-Reduction Potential of Water, D-1498-93.*

Orion Research, Inc., 1983. *Instruction Manual for Platinum Redox Electrodes.*

USGS, 1976. *Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents.* Techniques of Water-Resources Investigations, Book 1, Chapter D2.Eh DATA SHEET.

Eh DATA SHEET

DATE:
LOCATION:

Project Number:	Project Name:	Sample No.
Sampler(s):		
Meter (Model No.):	Reference Electrode:	Filling Solution:

Standard: Zobell _____ Date Mixed: _____ (Discard after 6 months)
Light's _____

MEASUREMENTS/CALCUATIONS

A) Temperature of Standard Solution, T_1 (°C)

B) $Eh_{Standard;}$ theoretical
For Zobell: $Eh_{Zobell;}$ theoretical = 428 + 2.2 (25 – T) (mV)
For Light's: $Eh_{Lights;}$ theoretical = 675 mV

C) $E_{(Standard);}$ measured (mV)

D) $Eh_{(ref.\ electrode)}$ at T_1 (mV) for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

E) $Eh_{(Standard)} = E_{(standard);}$ measured + $E_{(ref.\ electrode)}$ (mV) E = C + D

F) Difference between theoretical and measured Eh of standard

$Eh_{(standard);}$ theoretical – $Eh_{(standard)} > \pm$ 10 mV? B – E > ± 10 mV?

If yes, then: 1) check temperature
2) replace electrode filling solution
3) replace standard

G) Temperature of sample, T_2 (°C)

H) $E_{(Sample);}$ measured (mV)

I) $Eh_{(ref.\ electrode)}$ at T_2 for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

J) $Eh_{(Sample)} = E_{(Sample)} + Eh_{(ref.\ electrode)}$ (mV) J = H + I

REFERENCES:
D1498.

1. American Society for Testing and Materials (ASTM), 1981. Standard Practice for Oxidation-Reduction Potential of Water,
2. Orion Research, Inc, 1982. Instruction Manual for Platinum Redox Electrodes.
3. USGS, 1976. Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents. Techniques of Water-Resources Investigations, Book 1, Chapter D2.

DATA RECORD

Date	Time	Location or Sample	T_1 (°C)	$Eh_{(standard)}$ (mV)	$E_{(standard)}$ (mV)	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(standard)}$ (mV)	Check value (mV)	T_2 (°C)	$E_{(sample)}$ (mV	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(sample)}$ (mV)
			A	B	C	D	E (=C+D)	F (=B-E)	G	H	I	J (=H+I)
8/15/02	1500	Example 1	10°C	461	240	214	454	7	12°C	150	214	+364mV

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STANDARD OPERATING PROCEDURE No. 12

FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of dissolved oxygen in water samples. If necessary to accommodate specific field conditions, modifications to the procedure may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Dissolved Oxygen and Methodology

Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure. Gas solubility increases with decreasing temperature (i.e., colder water holds more oxygen). Gas solubility increases with decreasing salinity (i.e., freshwater holds more oxygen than does saltwater). Both the partial pressure and the degree of saturation of oxygen will change with altitude. Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen in water decreases as altitude increases because of the decrease in relative pressure.

Flowing water is more likely to have high dissolved oxygen levels than stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen as a result of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter.

The Membrane Electrode Method (such as that used on the YSI Model 55) is ideal for field dissolved oxygen (DO) testing. Polarographic or galvanic oxygen-sensitive membrane electrodes are composed of two metal electrodes in contact with a supporting electrolyte that is separated from the test solution by a selective membrane. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode. A thin permeable membrane, stretched over the sensor, isolates the electrodes from the environment while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes oxygen, which has passed through the membrane, reacts at the cathode causing a current flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. As oxygen partial pressure varies, so does the oxygen diffusion through the membrane. This causes the probe current to change proportionally.

2.2 Instrumentation and Equipment

Typically, obtaining a field DO measurement requires the following equipment:

1. Membrane Electrode-type Dissolved Oxygen meter
2. Platinum indicator electrode and reference electrodes of either calomel or Ag/AgCl
3. KCl reference electrode filling solution
4. Clean (e.g., deionized) water for probe cleaning
5. Squeeze bottle of clean water
6. Membrane/O-ring & KCl kit for probe cleaning and replacement

2.3 Instrument Checks and Calibration

2.3.1 Probe Operation and Precautions

Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes,

or from large (more than ½ inch dia.) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, replace the membrane and the KCl solution. The average replacement interval is two to four weeks.

1. If the membrane is coated with oxygen consuming material (e.g., bacteria) or oxygen evolving organisms (e.g., algae), erroneous readings may occur.

2. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are present.

3. Avoid any environment that contains substances that may attack the probe materials. Examples of some of these substances are concentrated acids, caustics, and strong solvents. Probe materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.

4. For correct probe operation, the gold cathode must always be bright. If it is tarnished, which can result from contact with certain gases, or plated with silver, which can result from extended use with a loose or wrinkled membrane, the gold surface must be restored. To restore the cathode you may either return the instrument to the factory, or clean it using a meter-specific reconditioning kit. Never use chemicals or abrasives not supplied with the kits.

5. It is also possible for the silver anode to become contaminated, which will prevent successful calibration. To clean the anode, remove the O-ring and membrane and soak the probe overnight in a 3% ammonium hydroxide solution. Next, rinse the sensor tip and KCl reservoir with deionized water, add new KCl solution, and install a new membrane and O-ring. Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are unable to calibrate, return the instrument to the manufacturer for service.

6. If the sensor O-ring is worn or loose, replace it with an appropriate O-ring.

7. To keep the electrode from drying out, store the probe in the instrument calibration chamber with a small piece of moist towel or sponge.

8. Consult the operations manual of the electrode instrument for the correct, instrument-specific calibration procedure.

2.4 Sample Measurement Procedures for Groundwater

Dissolved oxygen measurements should be taken during well purging and immediately before and after sample acquisition using a direct-reading meter. Because most well purging techniques allow aeration of collected groundwater samples, it is important to minimize potential aeration by taking the following precautions.

1) Purge well with a peristaltic pump to prevent downhole aeration of the sample in wells screened across the water table. Well drawdown should be kept to a minimum as described in PBW SOP No. 10 entitled (Water Quality Sampling). The pump tubing should be immersed alongside the dissolved oxygen probe beneath the water level in the sampling container (i.e., a flow-through cell). This will minimize aeration and keep water flowing past the dissolved oxygen probe's sampling membrane. If bubbles are observed in the tubing during purging, the flow rate of the pump must be slowed.

2) Dissolved oxygen measurements can be used as a stabilizing parameter in conjunction with other indicator parameters (i.e., pH, temperature, conductivity, etc.) to distinguish between formation water and stagnant casing water. Once these parameters have stabilized (typically ± 10% for DO), a representative DO measurement can be recorded from the in-line flow cell. Of the stabilization indicator parameters used above, DO usually requires the longest time for stabilization.

2.5 Documentation

All measurement results should be recorded according to procedures outlined in PBW SOP No. 1 entitled Field Documentation. The instrument manufacturer, model number and unique identification number should also be recorded with the measurement data.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Field measurements will be reviewed prior to their use on a project. The project manager or designated reviewer should verify the DO data and also confirm that documentation has been completed per this procedure.

4.0 REFERENCES

EPA, 1995. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.

YSI Inc., 1994. Operations Manual for YSI Model 55 Handheld Dissolved Oxygen System (Membrane Electrode Instrument).

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STANDARD OPERATING PROCEDURE No. 13

EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of reusable field equipment that could become contaminated during use or during sampling. The equipment may include split spoons, bailers, trowels, shovels, hand augers or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and also helps to maintain a clean working environment.

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is re-used between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids and Water Generated During Field Work or may be specified by a project plan.

2.0 PROCEDURES

2.1 Responsibilities

It is the responsibility of the field supervisor to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

2.2 Supporting Materials

1. Cleaning liquids: soap and/or detergent solutions (Alconox, etc.), tap water, distilled water, methanol, weak nitric acid solution, etc.
2. Personal protective safety gear as defined in the Site-Specific Health and Safety Plan.
3. Chemical-free towels or paper towels.
4. Disposable, nitrile gloves.
5. Waste storage containers: drums, boxes, plastic bags, etc.
6. Cleaning containers: plastic and/or stainless steel pans and buckets.
7. Cleaning brushes.
8. Aluminum foil.

2.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants may include an organic solvent wash step, and high levels of metals contamination may include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in sampling and analysis or work plan. Such variations in decontamination protocols may include all, part or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with tap water.

2. Wash with soap or laboratory-grade detergent solution.

3. Rinse with tap water.

4. Rinse with methanol (optional, for equipment contaminated by organic compounds).

5. Rinse with acid solution (optional, for equipment contaminated by metals).

6. Rinse with distilled or deionized water.

7. Repeat entire procedure or any parts of the procedure as necessary.

8. Air dry.

As appropriate, decontaminated equipment should be stored in sealable containers, such as Ziplock-type plastic bags or cases or boxes with lids.

3.0 DOCUMENTATION

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in PBW SOP No. 1 entitled Field Documentation.

4.0 QUALITY CONTROL

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a sampling and analysis or work plan or by the PBW project manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants should be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).

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STANDARD OPERATING PROCEDURE No. 14

STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the storage, testing, and disposal of soil, drilling fluids, and water generated during any field operations performed by PBW. The procedures presented herein are intended to be of a general nature. Appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Material Storage and Labeling

Potentially-contaminated materials should be collected and stored in water-tight, secured containers pending determination of their hazards. The containers should be stored temporarily at the site of origin. All steel drums used for storage will be Department of Transportation (DOT)-approved, so that hazardous materials may be transported in these drums if necessary. A daily inventory of the materials generated and the containers in which they are stored should be recorded on the Daily Field Record form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.2 Well Purging and Development Water

Water extracted from potentially-contaminated wells or piezometers for the purpose of development, sampling, or hydraulic testing should be stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; well or piezometer number(s); and "development water" if the water was extracted for development or "purge water" if the water was extracted for sampling or hydraulic testing, in addition to the other labeling requirements included Section 3.0 of this SOP.

2.3 Drilling Fluid

As appropriate based on site data, drilling fluid generated by hydraulic rotary drilling operations may be either spread out on the site or stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks depending on the contaminant distribution, if any, at the site. The containers should be labeled with an indelible marking including the date; boring, well, or piezometer number(s); and "drilling fluid," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.4 Soil Cuttings

Soil cuttings generated by drilling operations should be stored in sealed, 55-gallon, steel drums or in soil boxes with roll-top, lockable covers. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "cuttings," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.5 Wash Water

Water used to decontaminate equipment, by steam cleaning or other methods, that was used in potentially contaminated borings, wells or piezometers should be stored in sealed, 55-gallon steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "wash water," in addition to the other labeling requirements included Section 3.0 of this SOP.

2.6 Criteria for Hazard Determination

Analyses for hazard determination should be conducted by a laboratory certified by the applicable agency in the state in which the project site is located. Waste classification should be based on the criteria detailed in the applicable state and federal regulations.

2.6.1 Drilling Fluid and Cuttings from Exploratory Soil Borings and Well or Piezometer Installation

Evaluation of the hazard status for drilling fluid and cuttings from each boring, well or piezometer may be based upon the results of chemical analyses of the soil and groundwater samples collected from each boring, well or piezometer. Alternatively, representative samples of the drilling fluid and cuttings may be collected and analyzed.

2.6.2 Well Purging and Development Water

Evaluation of the hazard status for well purging and development water from each well or piezometer may be based upon the results of chemical analysis of the groundwater sample subsequently collected from each well or piezometer. Alternatively, representative samples of the purging and development water may be collected and analyzed.

2.7 Labeling

All drums containing waste should be labeled using self-adhesive labels placed on the side of the drums. The labels should be placed in a location on the drum such that the label can be easily read. At a minimum, the following information should be placed on the label using an indelible pen:

- Generator (client) name;
- Drum identification number (when more than one drum present);
- Description of contents, including boring, well or piezometer number(s), as appropriate;
- Date of generation;
- Technical contact (generally the name and phone number of PBW Project Manager); and
- PBW project number.

Local hazardous material storage regulations should also be reviewed for labeling requirements in addition to those listed above.

Appropriate hazardous waste labels should be used when analytical results indicate that the contents are hazardous waste.

2.8 Documentation

All of the information recorded on the drum labels should also be recorded in field notes completed at the work site. This information will be copied to the project file.

3.0 QUALITY CONTROL

3.1 Treatment and Disposal of Contaminated Materials

Soil, drilling fluid and water containing hazardous constituents should be treated and/or disposed of in accordance with all local, state and federal regulations. The appropriateness of on-site treatment versus off-site treatment and/or disposal should be evaluated by the PBW Project Manager based on the hazard determination.

3.2 On-Site Treatment of Contaminated Materials

Soil, drilling fluid, and water of known hazardous composition may be treated on-site provided: (1) such treatment is conducted in accordance with all local, state, and federal regulations based upon location, level of contamination, and volume of material; and (2) permission has been obtained as part of a site access agreement. On-site treatment may be feasible and economical if an on-site soil and/or groundwater treatment system is planned.

3.3 Transport and Disposal of Contaminated Materials

Hazardous waste that requires off-site disposal should be transported by certified hazardous material haulers to approved disposal sites in accordance with state and federal transportation regulations.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 15

HYDRAULIC TESTING

1.0 . SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during performance of a constant-discharge pumping test or a "slug test." The procedures presented herein are intended to be general in nature; as the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Constant-Discharge Test

The performance of a constant-discharge pumping test involves three phases: 1) pre-test measurements; 2) pumping portion of the test; and 3) recovery portion of the test. Pre-test measurements include water level measurements which indicate water level trends in the test area. These effects must be accounted for when test data are analyzed. The pumping portion of the test involves monitoring water levels in the pumping well and observation wells while the discharge in the pumping well is kept fairly constant. Groundwater samples may be collected during this phase. The recovery portion of the test occurs after pumping is stopped and involves the measurement of recovery water levels in the pumped well and observation wells.

2.1.1 Pre-Test Measurements

2.1.1.1 Water Level Measurements

Prior to conducting a pumping test, water level measurements should be taken in the pumped well and all observation wells (other monitoring wells and piezometers) to be monitored during the test to describe the pre-test potentiometric surface and its natural variability (refer to PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). Measurements in both the pumped well and observation wells should be taken at least every 4 hours for a minimum of three days before the pumping test begins. More frequent water level measurements in one or more wells using a continuous recording device may be used to substitute for the 4-hour measurement requirement in the pumped well and all observation wells.

Prior to beginning the pumping test, watches, the datalogger and other timing devices to be used in the test should be synchronized.

The water level measurements may be made with an electric water level probe, steel surveyors' tape or continuous recording device (Stevens recorder or pressure transducer/recorder). Accuracy of water level measurements prior to and during the aquifer test should be to within plus or minus 0.02-foot in the observation wells.

An observation well may be monitored continuously with a Stevens Type F water level recorder or a pressure transducer/recorder.

If water levels are measured by hand, all pre-test water level measurements for the pumping well and observation wells should be recorded on a Pumping Test Record form (Figure SOP-15-1). The same form should be used during the pumping portion of the pumping test.

2.1.1.2 Barometric Measurements

A record of barometric changes in the vicinity of the pumping test site should be obtained for the pre-test and test period. This record will be used to monitor changes in water levels caused by barometric effects. A recording barograph or record from a nearby weather station is acceptable.

2.1.2 Pumping Portion of Test

2.1.2.1 Measurements to be Taken

During the pumping portion of the pumping test, the following measurements should be made: 1) water levels in both the pumped well and the observation wells; 2) instantaneous and cumulative discharge from the pumped well; and 3) time at which these measurements are made. Samples of the discharge water may also be collected periodically during the test for chemical analysis or field testing. All should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the appropriate well.

2.1.2.2 Water Levels

Pumped Well:

The water level measurements in the pumped well should be taken according to the time schedule outlined below. More or less frequent measurements may be used.

Time Since Pumping Started			Time Intervals	
0	-	10 minutes	0.5- 1	minute
10	-	15 minutes	1	minutes
15	-	60 minutes	5	minutes
60	-	300minutes	30	minutes
300	-	1440 minutes	60	minutes
1440	-	shut down of pump	480	minutes (8 hours)

Observation Wells:

Stevens Type F continuous recorders or pressure transducer/datalogger may be installed in the observation wells. Water level measurements may be taken in these wells using an electric water level probe or steel surveyors' tape for calibration when the Stevens recorder or transducer/recorder is installed, and whenever the recorder chart paper is changed or the recorder is adjusted in any way. If a continuous recorder or pressure transducer/datalogger is not used, then water level measurements may be taken using an electric water level probe or steel surveyor's tape according to the following schedule:

Time Since Pumping Started			Time Intervals	
0	-	60 minutes	1	minute
60	-	120 minutes	5	minutes
120	-	240 minutes	10	minutes
240	-	360 minutes	30	minutes
360	-	1440 minutes	60	minutes
1440	-	shut down of pump	480	minutes (8 hours)

The time of measurements and water level measurement should be entered in the appropriate columns of the Pumping Test Record form (Figure SOP-15-1) for the pumped well and observation wells. If a Stevens recorder or pressure transducer/recorder is used, water level calibration and pertinent notes should be entered on the Pumping Test Record form.

2.1.2.3 Discharge Rate

Discharge from the pumped well should be measured using either of the following methods: 1) totalizing flow meter and stopwatch; 2) circular orifice meter; 3) Venturi meter; 4) Parshall flume; or 5) calibrated container and stopwatch. The discharge reading and time of reading should be entered on the Pumping Test Record form for the pumped well.

Discharge should be maintained within plus or minus 5 percent of the designated rate by means of a globe valve or other throttling device. Discharge should be checked and adjusted, if necessary, every 10 minutes during the first hour of pumping, at 30-minute intervals for the following 5 hours, and at one-hour intervals thereafter. Time of measurement and rate of discharge should be entered on the Pumping Test Record form for the pumped well (Figure SOP-15-1). If the pump is driven directly by an engine, the engine speed (in RPM) should be checked and noted every hour during the test. If the pump is run by an engine or a generator, the fuel level and the oil level in the engine or generator should be checked periodically, and fuel and/or lubricating oil added when necessary.

2.1.3 Sampling of Discharge Water

Samples of discharge water from the pumped well may be collected at time intervals specified by the Project Manager, provided such sampling does not interfere with water level measurements. The temperature, pH, and specific conductance of the samples may be measured in the field when the samples are collected. The samples should be preserved for subsequent chemical analysis by an authorized laboratory in accordance with PBW SOP No. 10 entitled Water Quality Sampling. The time the samples were collected and field measurements of water quality parameters should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the pumped well.

2.1.4 Duration of Pumping

The target duration of the pumping portion of each pumping test should be established prior to beginning the test. During the test, time-drawdown and/or distance-drawdown curves for the observation wells may be plotted on semi-logarithmic paper to assist in evaluating if the test is running well and deciding on the time that the pump should be shut off. If the plots indicate steady-state conditions (e.g., the interception of a recharge source), the test may be ended before its target duration. The pumping portion of the test may be extended, at the discretion of the Project Manager, to evaluate hydrologic boundaries or other transient conditions.

2.1.5 Aborted Test

Failure of pumping operations for a period greater than one (1) percent of the elapsed pumping time may require suspension of the test until the water level measured in the pumped well has recovered to within two (2) percent of the total drawdown in the pumped well during pumping. Recovery in the pumped well should be considered complete after the well has not been stressed for a period at least equal to the elapsed pumping time of the aborted test, or if any three successive water level measurements, at least 30 minutes apart, show no further rise in the water level in the pumped well. When recovery is complete, the pumping portion of the test may be resumed.

2.1.6 Recovery Portion of Test

After the pumping portion of the test has been completed, the pump should be shut off. Water level measurements may then be taken in the pumped well and observation wells in accordance with the approximate schedule presented below:

Time Since Pumping Stopped			Time Intervals	
0	-	15 minutes	1	minute
15	-	60 minutes	5	minutes
60	-	300 minutes	30	minutes
300	-	1440minutes	60	minutes
1440	-	End of test	480	minutes (8 hours)

Water level measurements should continue in the pumped well and observation wells until the water level in the pumped well has recovered to its pre-pumping level, or until a length of time equal to the pumping period has elapsed.

The water level data (water level below MP) and time at which measurement is made for each well should be entered on a Pumping Test Record form (Figure SOP-15-1), using the columns for the recovery portion of the test.

2.1.7 Pump Discharge

The water discharged from the pumped well should be prevented from entering the water-yielding zone being tested. If concentrations of chemicals in the discharged water are suspected to be above regulatory limits for discharge to natural water courses, the water from the pumped well should be collected for appropriate treatment and/or disposal.

2.2 Slug Tests

Falling-head or rising-head tests ("slug tests") may be performed on piezometers and monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Although the radius of influence (i.e., portion of the water-yielding zone tested) is smaller for a slug test than for long-term pumping tests, this testing method is often selected due to the low productivity and/or small available drawdown in wells. Another important consideration is that many locations can be evaluated with the slug test method for the same level of effort and cost of one pumping test.

2.2.1 Testing Equipment

A slug test consists of instantaneously raising or lowering the water level in a well and then monitoring the change of the water level through time. The slug tests should be performed by rapidly submerging (slug-in test) or retracting (slug-out test) a slug of known volume. A typical slug used in 2-inch wells is constructed of a sealed, 1-inch diameter, stainless steel pipe. The displacement volume of the slug should be measured prior to the test program.

A pressure transducer with an appropriate operating range should be used to measure the water levels during the slug tests. The pressure readings should be recorded and converted to feet of water above the transducer using a datalogger. The datalogger should be programmed to record the water levels at one-second intervals at the beginning of a test and to logarithmically increase the sampling interval to several minutes toward the end of the test.

2.2.2 Testing Procedure

Upon arrival at a test well site, the static water level and total depth of the well should be measured with an electric water level probe or steel surveyors' tape (see PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). The pressure transducer is then secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time should be allowed for the water level in the well to adjust to the displacement caused by the transducer and cable, and for the transducer to equilibrate to the water temperature. During this period, the water level in the well should be monitored electronically using the datalogger and measured periodically with the electric water level probe or steel surveyors' tape to confirm that static water level conditions exist. Next, the

slug should be lowered to a point just above the water level in the well and then rapidly submerged to begin the test.

As data are collected, the water levels displayed by the datalogger should be examined to monitor trends and the progress of the test. Manual water level measurements also should be taken during the test to confirm the transducer readings and documented on the Slug Test Form (Figure SOP-15-2). Each test should proceed until the water level attains at least 95 percent recovery from the slug displacement. Following completion of the slug-in test, a slug-out test should be performed by rapidly pulling the slug out of the water and monitoring the recovery of water level in the same manner as for the slug-in test. In some cases, more than one slug-in and/or slug-out test may be performed to provide additional confirmation of the results.

2.2.3 Equipment Decontamination

Prior to the first slug test and between each test, the slugs, transducer, cable and water level probe (or steel tape) should be decontaminated in accordance with PBW SOP No. 13 entitled Equipment Decontamination.

2.3 Data Analysis

2.3.1 Data Processing

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a cassette tape or to a computer in the field. If not transferred directly to a computer, these data are subsequently transferred to a computer for field data quality checks and data analysis. When transferred to computer, the data sets are transferred to files in comma-delineated ASCII format. The contents of each data file are imported to a spreadsheet program which allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone.

2.3.2 Slug Test Data Analysis

Slug tests in confined zones should be analyzed primarily by the method described by Cooper, Bredehoeft and Papadopulos (1967), whereas slug tests in semi-confined to unconfined water-yielding zones should be analyzed by the method discussed by Bouwer and Rice (1976). The Bouwer and Rice (1976) method is also applicable to confined aquifers and may be used to compare the results of the Cooper et al. (1967) method for confined aquifers.

Summary of Cooper, Bredehoeft and Papadopulos Method

Cooper et al. (1967) derived a solution using a partial differential equation for radial flow for the response of a finite-diameter well to an instantaneous "slug" of water. The method of analysis involves plotting the results of the slug test as H/H_o versus log t (time), where:

H = head inside the well above or below the initial head at time t after injection or removal of the slug.

H_o = head inside the well above or below the initial head at the instant of injection or removal of the slug.

The slug test plot is then compared against a set of "Type Curves" derived and published by Cooper et al. (1967) and Papadopulos, Bredehoeft and Cooper (1973), using a curve matching method, such that curves are moved parallel to H/H_o to match each other. When the best match between the data plot and type curves is obtained, a value of t is selected at the $Tt/r_c^2 = 1$ match point. The transmissivity (T) is then calculated using the following equation:

$$T = \frac{r_c^2}{t}$$

where: r_c = radius of the well casing.

The hydraulic conductivity (K) is obtained from the T value by:

$$K = \frac{T}{b}$$

where: b = thickness of water-yielding zone.

This method assumes that the water-yielding zone is homogeneous, isotropic, and of uniform thickness, and that the tested well is screened throughout the thickness of the water-yielding zone.

Summary of Bouwer and Rice Method

Bouwer and Rice (1976) presented a procedure for analysis of slug test data from an unconfined aquifer. Based on an electrical analog, Bouwer and Rice provided a convenient set of curves relating the effective radius (R_e) to the other well dimensions. This procedure is based on a modification of the Theim equation for steady state groundwater flow.

$$K = \frac{r_c^2 \ln(R_e / r_w)}{2L} \frac{1}{t} \frac{\ln^{Y_0}}{Y_t}$$

where:

K	=	Hydraulic conductivity
L	=	Screen length
Y_o	=	Head of water at time (o)
Y_t	=	Head of water at time (t)
t	=	Time
r_c	=	Inside radius of casing
r_w	=	Radius of casing plus thickness of filter pack
R_e	=	Effective radius (value of R_e obtained from the set of curves given by Bouwer and Rice)

This method estimates the hydraulic conductivity without calculating transmissivity. The results of the slug tests are plotted as a semi-logarithmic graph of Y_t versus t. The values of Y_t, Y_o, and t are obtained from the straight-line portion of the graph, and the value of K is calculated.

If the water level fluctuates within the screened interval or below the base of the bentonite seal in the well, the following correction will be made to include the porosity of the filter pack in the cross-sectional area of the well (Bouwer and Rice (1976)):

$$r_c = \left\{r^2 + n\left(R^2 - r^2\right)\right\}^{0.5}$$

where:

r_c	=	radius of the well including estimated filter pack porosity
r	=	radius of the well screen
n	=	estimated porosity of the filter pack
R	=	radius of the bore hole

3.0 QUALITY ASSURANCE

3.1 Calculation Check

All data and calculations recorded on the Pumping Test Record should be reviewed prior to use. The reviewer should be a technically qualified hydrologist or hydrogeologist, as designated by the PBW Project Manager. Record of the calculation review should be made by the reviewer's initials and date of review on the original Pumping Test Record form.

3.2 Records Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

4.0 REFERENCES

Bouwer, Herman and R. C. Rice, 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, Vol. 12, No. 3, pp. 423-428, June.

Bouwer, Herman, 1989 *The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 3, pp. 304-309, May-June.

Bouwer, Herman, 1989. *Discussion of "The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 5, pp. 715, September - October.

Cooper, Hilton H. (Jr.), John D. Bredehoeft, and Istavros S. Papadopulos, 1967. *Response of a Finite-diameter Well to an Instantaneous Charge of Water.* Water Resources Research, Vol. 3, No. 1, pp. 263-269.

Papadopulos, Istavros S., John D. Bredehoeft, and Hilton H. Cooper (Jr.), 1973, *On the Analysis of 'Slug Test' Data.* Water Resources Research, Vol. 9, No. 4, pp. 1087-1089, August.

FIGURE SOP-15-1. PUMPING TEST RECORD

PUMPING TEST RECORD

☐ OBSERVATION WELL _____
☐ PUMPING WELL _____

PAGE _____ OF _____

PROJECT AND LOCATION				PROJECT NO.	DATE
PUMPING WELL		OBSERVATION WELL		TIME STARTED	TIME FINISHED
RADIUS	DEPTH	DEPTH	DISTANCE (OBS TO PUMP)	MEASURING POINT (ELEV)	CASING HEIGHT
SCREEN INTERVAL		PUMP SETTING		DATALOGGER	
PUMP/ELECTRICAL EQUIPMENT				PERSONNEL	
COMMENTS					

			WATER LEVEL DATA			PUMPING DATA			WATER QUALITY			REMARKS
DATE AND TIME	TIME SINCE START OF PUMPING, t (MIN)	TIME SINCE PUMPING STOPPED, t' MIN)	WATER LEVEL BELOW MP (FEET)	DRAWDOWN, s (FEET)	RESIDUAL DRAWDOWN, s' (FEET)	PUMPING RATE) (GPM)	CUMULATIVE DISCHARGE) (GAL)	METER READING (GAL)	TEMPERATURE (°C)	pH	SPECIFIC CONDUCTANCE (umhos/cm)	

PASTOR, BEHLING & WHEELER, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
(512) 671-3434
Fax (512) 671-3446

FIGURE SOP-15-2. SLUG TEST FORM

SLUG TEST FORM

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
Phone: (512) 671-3434 Fax: (512) 671-3446

Date Tested:	Well No.:
Slug IN or OUT:	Measuring Point (MP):
Well Diameter (in.):	MP Height (ft. above ground level):
Well Depth (ft. BGL):	Slug Type (stainless, PVC, Teflon):
Screen Interval (ft. BGL):	Slug Length (ft.):
Starting WL (ft. BMP):	Slug Diameter (ft.):
Decon. Procedures:	Slug Volume (cu. ft.):
	Expected Well Response (+/- ft.):
Start Time:	End Time:
	Performed by:

Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)

Benchmark Ecological Services, Inc.
Standard Operating Procedures

SOP Number	Title	Revision Date
	Sediment Sampling	
SOP-BESI-101	Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Sampling Device for Saltwateror Freshwater Sediment	9/14/2003
SOP-BESI-102	Collecting Sediment Samples with a Piston Corer	9/14/2005
	Biota Sampling	
SOP-BESI-303	Collection of Finfish and Crabs Using Gill Nets	9/14/2003
SOP-BESI-304	Collection of Blue Crabs Using Commercial Crab Traps	9/14/2005
	Field Collection Instruments	
SOP-BESI-401	YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures	9/14/2005
SOP-BESI-402	YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation	9/14/2005
SOP-BESI-403	Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System	9/14/2005
	Sample Processing & Handling	
SOP-BESI-502	Sample Shipping and Freezing Procedures	3/01/06
SOP-BESI-503	Compositing Sediment Samples	9/14/2005
SOP-BESI-506	Measuring Crab Carapace Width and Wet Weight	9/14/2005
SOP-BESI-507	Crab Tissue Processing	9/14/2005
SOP-BESI-508	Measuring Fish Length and Wet Weight	9/14/2005
SOP-BESI-509	Fish Tissue Processing	9/14/2005
SOP-BESI-600	Water Sampling via Peristaltic Pump	3/01/06
SOP-BESI-601	Decontamination of Tubing and Filters for Water Sampling	3/01/06

STANDARD OPERATING PROCEDURE
SOP-BESI-101

TITLE: Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Device

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

COLLECTING SEDIMENT SAMPLES WITH A PONAR GRAB, ECKMAN GRAB OR EQUIVALENT DEVICE

1.0 PURPOSE AND APPLICABILITY

This SOP describes the proper procedures for operating a sediment sampler to collect surficial sediment (0-6 inches deep), and handling sediment samples after collection. The purpose is to obtain surficial sediment samples using a Ponar Grab, Ekman Grab or equivalent sampling device.

2.0 DEFINITIONS

Surficial sediment – Material from the top layers of sediment. Sediment from the 0-6 inches layer are generally considered surficial. The depth to be sampled must be specified.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure to reduce exposure to contaminants that may be present in the water or sediment.

3.2 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

3.3 Proper lifting techniques should be utilized when handling heavy objects.

3.4 General boat safety criteria should be practiced at all times, including awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Ponar grab sampler
- Ekman grab sampler
- Messenger
- Rope or Stainless Steel Pole
- Tub (to receive filled sampler)
- Stainless steel bowl
- Stainless steel or Teflon® spoons
- Sample jars

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 A Ponar grab, Ekman grab (or equivalent) will be used to collect surficial sediments. Grab samplers generally have an open or screened top to allow water to pass through the sampler as it descends, reducing forward wake, which can disturb surface sediment. The grab sampler is attached to a low-stretch rope or stainless steel pole.

8.2 The clean sampler is placed in a clean tub or on another clean surface on the deck of the boat. If the sampler has a safety pin, it will be removed when the sampler is safely over the sample station. To prevent forward wake, the sampler should not descend faster than 0.2 m/sec when as it nears the bottom. If the sampling depth is shallow, the grab will be lowered at approximately 0.2 m/sec until it enters the sediment. In deep water, the descent can be faster but must be slowed to about 0.2 m/sec several meters before it enters the sediments. If sampler requires a trigger/messenger, attach messenger to the line and release.

8.3 Retrieval of the sampler, after it has settled into the sediment, must be slow to ensure proper closure of the jaws. The sampler should be retrieved at a speed of 0.3 m/sec. The sampler should be lifted slowly from the water and quickly secured to prevent swinging. Rapid retrieve or swinging may disturb surface sediments. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment sloshing.

8.4 A sample is acceptable if it is covered with water (indicates the sampler is not leaking), and surface sediment is relatively flat and undisturbed. Because of the action of the closing jaws, some samples may be flat and undisturbed only in the center. If a sample is not acceptable it should be set aside (do not dump overboard), and a second sample should be collected. Unacceptable samples can be discharged overboard after an acceptable sample is collected.

8.5 Samples may also be considered unsuitable if there is less than 6 inches of sediment in the sampler. If necessary, the sample station may be relocated and the change documented in the sample log.

8.6 If measurements are to be taken from water overlying the sediment sample, they must be taken before the sample is disturbed or overlying water must be collected for the measurements.

8.7 Prior to removing sediments from the sampler, the overlying water will be siphoned off with a piece of tubing, or the grab sampler will be drained by gently tilting it.

8.8 If sub-samples are needed, they may be collected from the top of the closed sampler using a spoon, scoop, or core tube. Sediment for chemical and biological analyses will be removed using pre-cleaned stainless steel spoons and composited using pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used.

8.9 The empty sampler should be rinsed and decontaminated using water and Alconox® or an

equivalent cleaning chemical, and rinsed with deionized water. The sampler and associated equipment is decontaminated before use and between sample sites. In addition, the sampler will be rinsed with site water before samples are collected. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment depth, basic sediment characteristics, station coordinates, sample time and processing time.

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers,
- Penetration depth of the sampler and/or general depth of sample taken (i.e., top 2 cm, 2-10 cm, etc.), and,
- Comments that relate to sample quality such as leakage, winnowing, disturbance.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-102

TITLE: Collecting Sediment Samples with a Piston Corer

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

COLLECTING SEDIMENT SAMPLES WITH A PISTON CORER

1.0 PURPOSE AND APPLICABILITY

To collect sediment samples with a piston corer in a safe and efficient way.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personnel from possible contaminants that may be present in the water or sediment.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

3.4 Respirators may be required when sampling sediment contaminated with toxic volatiles. Respirators must fit properly and the appropriate cartridges must be available.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and sample stations.

6.0 EQUIPMENT AND MATERIALS

- Piston corer head and rope
- Pistons (minimum of 2)
- Depth weight and rope
- Sufficient length of piston corer poles
- Wire-lock pins for the piston corer pole extensions
- Sufficient number of pre-cleaned core tubes
- Drill bit for punching holes in core tube
- Clamps for the core tube connection to the piston head (minimum of 2)
- Flat head screw driver or nut driver
- Core stoppers
- Nitrile gloves
- Safety glasses
- Paper towels
- Core tube brush

- Core tube cutter
- Measuring tape
- Alconox
- Global Positioning System (GPS)
- Data Sheets
- Sample Platform
- Extruding Device (if cuts are required)

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Site location and positioning

8.1.1 Sample personnel will locate sample stations using maps, GPS (SOP-BESI-403), and/or field markers.

8.1.2 Once sample stations have been identified in the field, the sampling platform may be held on station with the use of anchors, tying off to existing structures and/or the sample platform motor.

8.1.3 Mark and record the sample station with the GPS (SOP-BESI-403).

8.2 Collecting sediment with the piston corer (Figure 2)

8.2.1 Determine water depth from the sample platform to the surface of the sediment by lowering a weight from the sample platform. When the weight contacts the sediment surface the rope is calibrated by tying it off to the sample platform. Raise and remove the weight from the calibrated rope.

8.2.2 Insert piston rope through a pre-cleaned core tube and connect piston to rope.

8.2.3 Attach core head to core tube using at least one clamp.

8.2.4 Connect piston rope to sediment depth-calibrated rope.

8.2.5 Lower the core tube into the water at least 2/3 the length of the core tube allowing water to enter the core tube before pulling the piston into the core tube.

8.2.6 Attach pole extension(s) to the core head and lower the core tube and pole extension(s) into the water. Continue to attach pole extensions as the core tube is lowered.

8.2.7 When the core tube hits the sediment surface, the calibrated depth rope fixed to the sample platform will pull the piston up through the core tube as the core tube is pushed into the sediment.

8.2.8 Continue to push the core tube into the sediment until point of refusal or the core tube has been fully inserted into the sediment.

8.2.9 Raise the core tube and remove pole extensions as the piston corer is brought to the sample platform.

8.2.10 Prior to bringing the core tube onto the deck of the sample platform, place a pre-cleaned core stopper on deck

8.2.11 Quickly raise the core tube onto the deck and set it down on top of the pre-cleaned core stopper.

8.2.12 Secure the core tube on the deck and drain the water above and below the piston by placing holes in the core tube.

8.2.13 Allow the water to drain, and remove the piston from the core tube.

8.2.14 The core is now ready to be processed by either extruding the sediment out of the

top of the core tube or dumping the sediment out of the bottom of the core tube.

8.2.15 Record the water depth, sediment core depth, station coordinates, and sample times onto appropriate data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the core tube, piston and core head in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment core depth, basic sediment characteristics, station coordinates, sample time and processing time.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-303

TITLE: Collection of Finfish and Crabs Using Gill Nets

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to obtain finfish and shellfish specimens from shallow aquatic habitats using gill nets. This SOP describes the proper procedures for using gill nets to collect finfish and crabs from shallow aquatic habitat. Gill nets are usually used in shallow water near the shoreline, but may be used in deeper water if properly weighted and anchored. Gill nets with different mesh sizes can be used to target specific sized fish.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personal from possible contaminants that may be present in the water.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Monofilament gill nets
- Wooden poles (2x2)
- Inertia driver (for wooden poles)
- Concrete anchors
- Polypropylene or nylon rope (3/8-1/2 in diameter)
- Styrofoam floats
- Net picks
- Net tags
- Nitrile gloves
- Measuring board
- Re-sealable plastic bags
- Labels
- Permanent marker pens
- Ice chest with ice

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Gill nets can be purchased with many different mesh sizes and monofilament line strength. The size and strength of the primary target specie, or species will determine which mesh size and line strength should be used.

8.2 According to Texas law, gill netting is an illegal fishing method and may not be used unless persons using the nets are permitted by TPWD to use such methods. All gill nets must be tagged with the name of the user and the users TPWD permit number. Persons using gill nets must be in possession of a copy of the TPWD permit while the nets are in use.

8.3 Gill nets are used by vertically suspending the outstretched nets in areas where fish activity or traffic is heavy. Fish are caught in the nets as they attempt to swim through the mesh. Fish that are too large to pass through the mesh, will attempt to back out and will be snared by strands of the monofilament mesh under gills, scales, or spines.

8.4 Gill nets can be stretched across a fish pass or stream mouth, perpendicular to a shoreline, or parallel to a line of shoreline cover. Gill nets are set in an area used as a fish path or in an area that contains habitat utilized by the target fish species. Fish moving through or into the area may be caught in the net. A gill net is a passive fishing device and requires that the fish swim into it.

8.5 Gill nets are used by stretching the net across the area to be fished. An anchor should be attached to each end of the lead line of the net. Anchors hold the net down on the bottom and prevent it from being moved by water currents. Ends of the top line (float line) must be tied to structure (e.g., tree limbs, stumps, pilings) or a wooden stake driven into the bottom. For safety reasons, the stake should be visible above the waters surface.

8.6 Gill nets may be fished at any time the target fish are active, but they are generally most effective when set in the evening and fished through the night. Fish caught in the net will usually die quickly and should be removed from the net as soon as possible to prevent tissue deterioration. High water temperatures accelerate tissue deterioration.

8.7 A net is checked by raising it out of the water and removing captured fish from the mesh. Nets should be checked by starting at one end, and working toward the other end. Fish are removed from the net by hand; a net pick may be used to remove the fish. Nitrile gloves are worn to protect the hands of personnel and prevent contamination of the sample.

8.8 Gill nets are generally set and checked from the deck of a boat, but in water less than 3 ft, it may be more efficient to check the net by wading. If waders or hip-boots are worn, a personal flotation vest should be worn.

8.9 Fish removed from the nets should be placed in a fish basket or plastic tub until they are evaluated. Non-target species that are still alive must be returned to the water immediately.

8.10 Fish should be put in a labeled plastic bag and placed on ice in an insulated cooler.

8.11 Catch data should be recorded on data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment and samples.

10.0 DOCUMENTATION

General descriptive information of the sample site, catch, and field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of the sample area, bottom type, vegetation, and water depth,
- Location of the area sampled,
- List of species collected, and,
- Number and/or weight of organisms collected,
- Water temperature, salinity, and conductivity.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-401

TITLE: YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure dissolved oxygen and temperature parameters.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when taking measurements in potentially contaminated water.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 55 attached to this SOP.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Distilled water
- Nitrile gloves

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the attached YSI 55 owner's manual.

8.0 METHODS

8.1 Calibration

Before you calibrate the YSI Model 55, complete the procedures discussed in the Preparing the meter and preparing the Probe in the attached owners manual. The following procedure is taken from the YSI Model 55 owners manual.

To accurately calibrate the YSI Model 55, you will need to know the following information:

- The approximate altitude of the region of which you are located.
- The approximate salinity of the water you will be analyzing. Fresh water has a salinity of approximately zero. Seawater has a salinity of approximately 35 parts per thousands (ppt). If you are not sure about the salinity use the YSI 63 (SOP-BESI-402) to determine it.

8.1.1 Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.

8.1.2 Turn the instrument on by pressing the ON/OFF key on the front of the instrument. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required after turning the instrument on).

8.1.3 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time.

8.1.4 The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. Example: entering 1 here = 100 feet.

8.1.5 When the proper altitude appears on the LCD, press the ENTER key. The Model 55 should now display CAL in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current DO reading (before calibration) should be on the main display.

8.1.6 Make sure that the DO reading (large display) is stable, then press the ENTER key. The LCD will prompt you to enter the approximate salinity of the water you are about to analyze. You can enter any number from 0 to 40 parts per thousand (ppt) of salinity. Use the arrow keys to increase or decrease the salinity setting. When the correct salinity appears on the LCD, press the ENTER key. The instrument will return to normal operation.

For best results:

- Each time the Model 55 is turned off, re-calibrate before taking measurements
- Calibrate at a temperature within ±10°C of the sample temperature.

8.2 Taking Readings

8.3.1 After the system has been set up, it is ready to take readings. Turn the instrument on and allow it to complete the self-test procedure.

8.3.2 Rinse the probe with distilled water.

8.3.3 Completely immerse the probe into the sample matrix.

8.3.4 You can move back and forth from reading dissolved oxygen in the mg/L mode or the % air saturation mode by pressing the MODE key.

8.3.5 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the owner's manual located in the Benchmark Ecological Services, Inc. library.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

STANDARD OPERATING PROCEDURE
SOP-BESI-402

TITLE: YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Katy Garcia	[signature]	09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer	[signature]	09/14/05
Name	**Signature**	**Date**

Revision No. 1

YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure for conductivity, salinity, temperature and pH using a YSI 63 handheld meter.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when conducting the calibrations and when taking measurements in potentially contaminated water.

3.2 Avoid inhalation, skin contact, eye contact or ingestion of pH buffer and conductivity solution.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 63 located in the Benchmark Ecological Services, Inc. library.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Plastic 100 mL graduated cylinder
- pH buffers 4, 7, 10
- Distilled water
- Conductivity standard solution(s)
- Nitrile gloves
- Clean glass beaker

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the YSI 63 owners manual located in the Benchmark Ecological Services, Inc. library.

8.0 METHODS

8.1 pH Calibration

The following procedures are taken from the YSI 63 meter owner's manual.

8.1.1 Turn the instrument on by pressing the ON/OFF key. Press the mode key until pH is displayed.

8.1.2 Rinse the probe with distilled water, then carefully dry the probe (or rinse it with some of the pH buffer solution to be used for calibration).

8.1.3 Place 30 to 35 mL of the pH buffer you have chosen to calibrate the system with (pH 7) in the 100 mL graduated cylinder. Immerse the probe making sure that both the pH & temperature sensors are covered by the solution.

8.1.4 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time. The display will show CAL at the bottom, STAND will be flashing and the pH reading will show 7.00.

8.1.5 Press the ENTER key. The display will show CAL at the bottom, STAND will stop flashing and the pH calibration value is shown with the middle decimal point flashing. Flashes until reading is stable.

8.1.6 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the calibration point. The model 63 will flash SAVE on the display along with OFS to indicate that the offset value has been saved.

8.1.7 SLOPE will now appear on the display and be flashing. This indicates that the slope is ready to be set using a second pH buffer. The system is now calibrated at a single point. If you are only performing a single point calibration, press the MODE key to return to normal.

8.1.8 Rinse the probe with distilled water.

8.1.9 If performing a 2-point or 3-point calibration, fill a clean container with the second value (pH 4) pH buffer and immerse the probe into the solution. Make sure the temperature sensor is immersed.

8.1.10 Press the ENTER key. The display should now show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing.

8.1.11 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the fist slope. The display will flash SAVE along with SLP to indicate that the fist slope value has been saved.

8.1.12 SLOPE will start flashing again indicating that the slope is ready to be set using the third buffer.

8.1.13 The system is now calibrated for 2-points. If you are only performing a 2-point calibration, press the MODE key to return to normal.

8.1.14 Rinse probe with distilled water.

8.1.15 If performing a 3-point calibration, fill clean container with the third buffer (pH 10) and immerse the probe into the buffer.

8.1.16 Press the ENTER key. The display will show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing. The right decimal point should be flashing.

8.1.17 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the second SLOPE. The display will flash SAVE along with SLP to indicate that the second slope has been saved.

8.1.18 The system will return to normal. Rinse the probe with distilled water.

8.2 Conductivity Calibration

The following procedure is taken from the YSI 63 meter owner's manual.

8.2.1 Turn the instrument on and allow it to complete the self-test procedure.

8.2.2 Select a calibration solution that is most similar to the sample you will be measuring.

- For sea water choose a 50 µS/cm conductivity standard
- For fresh water choose a 1 µS/cm conductivity standard
- For brackish water choose a 10 µS/cm conductivity standard

8.2.3 Place about 7 inches into a clean plastic container or glass beaker. Do not use

graduated cylinder.

8.2.4 Use the MODE key to advance the instrument to display conductivity.

8.2.5 Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged.

8.2.6 Allow at least 60 seconds for the temperature reading to become stable.

8.2.7 Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.

8.2.8 Press and release the UP ARROW and DOWN ARROW keys at the same time. The CAL symbol will appear at the bottom left of the display to indicate that the instrument is in Calibration mode.

8.2.9 Use the UP ARROW and DOWN ARROW key to adjust the reading on the display until it matches the value of the calibration solution you are using.

8.2.10 Once the display reads the exact value of the calibration solution being used, press the ENTER key. The word SAVE will flash across the display for a second indicating that the calibration has been accepted. The instrument will hold that calibration until the next calibration. Therefore, there is no reason to recalibrate the instrument after changing the batteries.

8.3 Calibrating Salinity

8.3.1 Calibration is not an option for salinity, check to make sure the meter is reading correctly by completely immersing the probe in DI or Distilled water. The salinity reading should read zero.

8.4 Taking Readings

8.4.1 After the system has been calibrated, it is ready to take readings.

8.4.2 Rinse the probe with distilled water.

8.4.3 Completely immerse the probe into the sample matrix.

8.4.4 Shake the probe to dislodge any air bubbles from the probe.

8.4.5 Use the MODE key to scroll through the parameters to record your readings.

8.4.6 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the attached owners manual.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

STANDARD OPERATING PROCEDURE
SOP-BESI-403

TITLE: Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

Station Positioning Using Global Positioning System

1.0 PURPOSE AND APPLICABILITY

This SOP covers the procedures for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

2.0 DEFINITIONS

Global Positioning Systems (GPS) are multi-functional navigation systems that use satellites to calculate latitude and longitude. By computing the distance between three or more satellites and the ground receiver, the GPS system generates an accurate current location. When a sample station/site is selected, the GPS will aid in navigation to the exact latitude and longitude position.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Do not us a GPS unit as the sole method of navigation.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All personnel use this procedure to locate and record sampling stations and/or sites.

6.0 EQUIPMENT AND MATERIALS

- GPS (fully charged or external power source)

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 In order to navigate to a station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

8.2 When recording a sample station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

9.0 QUALITY CONTROL CHECKS

No quality control checks are necessary for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

10.0 DOCUMENTATION

See electronic copy of documents: Geo_300_GSG_46506-30-ENG.pdf, PathFinderOffice280_Vol3B_Eng.pdf, and TerraSync operations manual.pdf

STANDARD OPERATING PROCEDURE
SOP-BESI-502

TITLE: Sample Shipping and Freezing Procedures

The attached Standard Operating Procedure was revised by:

Neil Heathorne		3-1-06
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

William Quast		3-1-06
Name	**Signature**	**Date**

Revision No. 2

Sample Shipping and Freezing Procedures

1.0 PURPOSE AND APPLICABILITY

To ensure that samples are properly stabilized prior to shipment.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must be also available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- Prior to sample collection, the laboratory conducting analyses should be contacted by the Study Director, Project Manager, Field Crew Leader, or a designee to verify that the laboratory is prepared to accept the samples.

6.0 EQUIPMENT AND MATERIALS

- Cooler, freezer, or refrigerator
- Ice for cooler
- COC's
- Pen
- Sharpie

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Preparation of Samples Prior to Shipment:

8.1.1 In the field, samples shall be stored on ice.

8.1.2 Depending on the desired sample analysis, the sediment, tissue and water samples shall be either placed in freezers or coolers containing ice, or placed inside a refrigerator set at 4°C, until sample shipment occurs.

8.1.3 Fill out chain of custody (COC) form according to project SAP. Put COC form in plastic bag and tape to the inside top or lid of the sample shipment cooler, or placed with sample containers in their storage area.

8.1.4 If in an environment where people other than project staff can access samples, seal the freezer or cooler with a chain-of-custody label or lock to protect against tampering.

8.2 Shipping Instructions:

8.2.1 All samples are to be a hand delivered or shipped via overnight courier to the laboratory.

8.2.2 If water, tissue, or sediment samples are held for over 24-hours they should generally be kept on ice, or at a minimum, refrigerated prior to shipment. Check the project Sampling and Analysis for project-specific requirements.

9.0 QUALITY CONTROL CHECKS

There are no specific Quality Control Checks for this SOP

10.0 DOCUMENTATION

There are no specific Quality Control Checks for this SOP

STANDARD OPERATING PROCEDURE
SOP-BESI-503

TITLE: Compositing Sediment Samples

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

Compositing Sediment Samples

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to ensure that proper mixing of sediment samples occurs when compositing is required. This standard operating procedure describes the procedures for compositing sediment samples. After the samples are composited, they are split into different containers.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn when performing this procedure.

3.3 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile Gloves
- Stainless steel bowls
- Stainless steel spoons (Large and Small)
- Clean, labeled sample jars
- Clean, labeled VOCs jars

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Prior to splitting samples for analytical testing, representative samples must be taken for analysis of VOCs and semi VOCs.

8.1.1 Use a small stainless steel spoon to take sediment samples that collectively represent the sample.

8.1.2 Take representative samples until the VOC jar is filled.

8.1.3 Cap or close the container and handle according to SOP-BESI-502.

Note: You are dealing with volatile gases, therefore this must be completed in a timely manner.

8.2 The sediment must be homogenized in a thorough manner. Compositing is necessary when

samples are collected.

8.2.1.1 Thoroughly mix the sediments together with a large clean stainless steel utensil.

8.2.1.2 Mixing should occur for approximately 3-5 minutes per sample. To ensure the best possible results, mixing should be conducted in various clockwise, counterclockwise and chopping motions with emphasis being placed on folding the sediment from the outer edges of the container to the center.

8.2.1.3 After the sediment is homogenized, collect sub-samples from the sample and place them into the container until completely filled.

8.2.1.4 Cap or close the containers and handle according to SOP-BESI-502.

9.0 QUALITY CONTROL CHECKS

Gloves should be worn at all times while handling the sample.

10.0 DOCUMENTATION

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers.

STANDARD OPERATING PROCEDURE
SOP-BESI-506

TITLE: Measuring Crab Carapace Width and Wet Weight

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

MEASURING CRAB CARAPACE WIDTH AND WET WEIGHT

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for measuring crab carapace width and wet weight prior to tissue processing for chemical analysis.

2.0 DEFINITIONS

Carapace - Large shell that forms protective covering on most crabs.
Carapace width - Lateral distance across the carapace from tip of spine to tip of spine.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 MATERIALS

- Measuring Board
- Electronic balance
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any crab samples, all staff must wear nitrile gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the crab from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the crab.

8.2 Crab Carapace Width Measurement

1. Place the crab on a fish measuring board that it is upright exposing the carapace.
2. Measure and record the distance in millimeters across the carapace from tip of spine to tip of spine.

8.3 Crab Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place a piece of clean aluminum foil onto the weighing plate of a top loading balance and tare the balance to read, "zero".
2. Next, remove any excess water from the crab shell by patting dry with a Kimwipe.
3. Place the crab on the tared scale making sure that the entire organism is on the aluminum foil.
4. Record the weight of the crab in grams to the appropriate significant digit {balance dependant) on the data log forms.
5. Discard the aluminum foil after each separate crab sample is weighed, and, if necessary, remove the weighing plate from the top loading balance and wash with soap (Alconox) and warm water, followed by deionized water.

9.0 QUALITY CONTROL CHECKS

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

STANDARD OPERATING PROCEDURE
SOP-BESI-507

TITLE: Crab Tissue Processing

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

CRAB TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible crab tissue samples for analysis.

2.0 DEFINITIONS

Carapace – Large shell that forms protective covering on most crabs.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while using methanol, hexane, or 5 percent nitric acid.

3.3 Use of methanol or hexane should be under a fume hood.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Scalpels
- Top loading balance (0.1 gm)
- Stainless Steel Crackers
- Sample Container
- Freezer (chest or upright)
- Spatulas -stainless steel or Teflon coated
- Decontamination materials: DI water, soap, ultra-pure hexane, or methanol
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each crab with DI water to remove any gross field contaminants. Measure and weigh each crab according to SOP-BESI-506.

8.2 Claw Tissue Removal Procedure

Remove both claws from the body by breaking the joint between the basal segment (attached to the body) and the first leg segment. This will prevent the loss of muscle tissue from inside the body.

Crush the terminal segment of each claw (largest segment) with stainless steel claw cracker. Be careful not to crush the muscle tissue inside the claw. With gloved hands, remove the muscle with a spatula or scissors. Place the tissue directly into a sample container. The sample container should be on the balance and tared prior to processing the crab.

8.3 Body Tissue Removal Procedure

The first step is to remove the shell by flipping the crab over on the table or in the palm of the hand and locating the point where the rear of the carapace meets the underside of the crab. The crab's tail should be seen folding towards the front of the shell (will be narrow and pointed in males and wide and round in females). Grasp the end of the tail and pull towards the rear of the crab. Once the tail is lifted, a small gap should appear providing a finger hold for grasping the rear of the carapace and tearing it from the rest of the crab's body. Removal of the upper carapace will expose the gills (white spongy tissue at the perimeter of the body}, and the digestive gland (yellow to brown tissue in the center of the body) .The gills and digestive gland should be removed by scraping with a spatula or scalpel. The remaining body half should be rinsed with deionized water. After the gills and digestive gland are removed, a series of muscle filled chambers (separated by thin shell) will be seen on both sides of the body. Remove the shell covering the chambers with the scissors and scrape out the muscle tissue with a spatula or scalpel. Place the tissue in the sample jar on the balance along with the claw muscle. Record the weight of all the tissue removed from the crab.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with DI water.
4. Rinse thoroughly with ultra-pure hexane or methanol (for organics; or 5% nitric).
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage. Ship frozen samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for crab tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., scissors) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-508

TITLE: Measuring Fish Length and Wet Weight

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

FISH LENGTH AND WEIGHT PROCEDURES

1.0 PURPOSE AND APPLICABILITY

The purpose of this procedure is to accurately measure the length and weight of fish prior to tissue processing and chemical analyses. Whole fish samples will be collected in the field for chemical analysis. As soon as possible after collection, and prior to tissue removal and processing, accurate measurements of fish length and weight should be recorded. If possible, these measurements should occur on the sample vessel immediately after collection to prevent weight changes resulting from fluid loss after the organisms die.

2.0 DEFINITIONS

Caudal Fin - posterior-most unpaired fin (i.e., tail).

Total Length - length from anterior-most point of nose to the tip of the longest caudal fin ray when the lobes of the caudal fin are compressed dorsoventrally.

Standard Length - length from the anterior-tip of the nose to the posterior tip of the hypural plate.

Fork Length - length from the anterior-most point of the nose to the notch in the tail fin of fork-tailed fishes.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

No specific health and safety considerations are necessary other than the general procedures outlined in the health and safety plan.

4.0 QUALITY ASSURANCE PLANNING CONSIDERA TIONS

No study-specific variances from this sap are anticipated.

5.0 RESPONSIBILITIES

It is the field study manager's responsibility to ensure that all field staff is familiar with this SOP.

6.0 TRAINING/QUALIFICA TIONS

No special training or qualifications other than knowledge of this sap are needed to accurately measure and weigh fish.

7.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Deionized water
- Electronic balance
- Measuring board
- Data log forms
- Decontamination materials
- Aluminum foil.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any fish samples, all staff must wear powder-free latex gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the fish from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the fish.

8.2 Fish Measurement

1. Place the fish on the measuring board on its side so that the tip of its nose (anterior) is touching the stop plate at the beginning of the tape measure.
2. Slide the measuring scale to the point on the fish corresponding to the desired measurement (i.e., total length, fork length, standard length) and record the value on the data log forms.

8.3 Fish Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place the fish on the tared scale and record the weight of the fish to the appropriate significant digit (balance dependant) on the data log forms.
2. Clean and tare scale prior weighing the next sample.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

STANDARD OPERATING PROCEDURE
SOP-BESI-509

TITLE: Fish Tissue Processing

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

FISH TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible fish tissue samples for analysis.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while filleting tissue and while using hexane.

3.3 Use of hexane should be under a fume hood or in a well ventilated area.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Fish scaler
- Aluminum foil
- Electric fillet knife, fillet knife
- Stainless steel fillet blades
- Cutting board
- Top loading balance (0.01 gm)
- Cooler (chest or upright)
- Decontamination materials: DI water, soap, ultra-pure hexane
- Labels
- Marking pens
- Freezer grade Zip Loc
- Finfish processing forms
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each fish with DI water to remove any gross field contaminants. Measure, weigh, and label each fish according to appropriate SOP (SOP-BESI-508).

8.2 Fish Scale Removal Procedure

Remove fish scales from fish so as scales will not be processed into the edible tissue sample. Wear nitrile gloves and safety glasses when scaling fish. Once the fish has been scaled, rinse the fish with DI water, and store on ice until the sample can be filleted.

8.3 Body Tissue Removal Procedure

Fillet the fish with your choice of pre-cleaned utensils (electric fillet knife, regular fillet knife). Sample fillet should represent the edible portion of each fish. Record the weight of the tissue removed from each fish. Double-wrap the tissue in aluminum foil that has been pre-rinsed in hexane, double-bag the foil wrapped tissue in labeled re-sealable Ziploc bags, and place in secure cold storage.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with Dl water.
4. Rinse thoroughly with ultra-pure hexane.
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage until shipment. Ship samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for fish tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., fillet knives) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-600

TITLE: Water Sampling via Peristaltic Pump

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Neil Heathcote	Neil Heathcote	3-1-06

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
Bill Quast	William Quast	3-1-06

Revision No. 2

Water Sampling via Peristaltic Pump

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting water sampling via peristaltic pump.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^{R} tubing
- Cable ties
- Filter
- 12 Volt battery
- Boat
- Pre cleaned sample bottles

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

All tubing and filters should be pre-cleaned prior to sampling using the cleaning procedures described in SOP-BESI-601. The pump may be used to circulate the cleaning solutions and rinsate through the tubing.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert a predetermined length of C-Flex^{R} tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^{R} tubing will be determined by the depth at which the water sample will be collected. If required connect a filter downstream of the peristaltic pump. Filter requirements and sizes will be listed in the SAP.

8.3 Tube Purging Procedures

After lowering the intake end of the tubing to the desired collection depth, purge the system for a minimum of one minute by pumping site water through the tubing. The purge time may be increased depending on the depth of sampling and the length of the tubing. If analytes require filtration the filter should be connected to the tubing before purging. Project Manager should designate the purge time prior to field collection.

8.4 Sampling Procedures

Filtered samples are collected directly into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis. Unfiltered samples will be collected after the filter is removed from the tubing. Unfiltered samples will be collected into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis.

8.5 Labeling Procedures

The sample containers will be labeled according to project requirements. Chain of Custody forms will be completed immediately after sample collection.

8.6 Sample Storage for Shipment

The water sample is then placed in a resealable Ziploc^{R} bag and placed in the sample holding container on ice according to SOP-BESI-502.

8.7 In-situ Measurement Procedures

In-situ measurements will be taken at the time of sample collection using a YSI 55 Meter and a YSI 63 Meter, in accordance with SOP-BESI-401 and SOP-BESI-402, respectively.

8.8 Field Data Recording Procedures

General descriptive information and the appropriate field data should be entered onto the field data log.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for water sampling via peristaltic pump may consist of rinsate blanks to ensure the processing equipment (i.e., tubing and filters) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Deionized water (DI water) will be pumped through the tubing and filter(s) to be used during the field collection. The DI water will be collected in appropriate sample containers and placed on ice for shipment to the laboratory for analysis.

10.0 DOCUMENTATION

When sending water samples to the analytical laboratory, follow the appropriate chain-of-custody and shipping documentation requirements.

STANDARD OPERATING PROCEDURE
SOP-BESI-601

TITLE: Decontamination of Tubing and Filters for Water Sampling

The attached Standard Operating Procedure was revised by:

Neil Heathouse		3-1-06
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

William Quast		3-1-06
Name	**Signature**	**Date**

Revision No. 2

Decontamination of Tubing and Filters for Water Sampling

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting decontaminating tubing and filters used in water sampling studies.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Work under an air hood or in a well ventilated room when working with HCL.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^{R} tubing
- Cable ties
- Filter(s)
- 12 Volt battery
- 10 % HCL Solution
- Deionized Water

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Mix a 10% HCL Solution with Laboratory Grade HCL and Deionized (DI) Water.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert C-Flex^{R} tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^{R} tubing will be determined by the project or may be pre-cut for specific sample stations. If required for the field study, connect filter(s) downstream of the peristaltic pump. Filter requirements and filter sizes will be determined by the analyte list and the analytical methods.

8.3 Tube and Filter Cleaning

Pump 10% HCL solution through the tubing and filter(s) for five minutes. Clear the tubing and purge the tubing and filter(s) with DI Water for 5 minutes.

8.4 Packaging Clean Tubing and Filter(s)

If tubing has not been cut for specific sample stations then cut tubing to desired length for each of the sample stations. Once the tubing has been cut and clean filters (if needed) are properly connected, place the tubing ends inside a clean Ziploc bag. In most cases the entire length of tubing will not fit inside a Ziploc, use a cable tie to seal the Ziploc bags around the tubing ends. Place the tubing and filter(s) inside of two clean kitchen bags.

8.5 Labeling Procedures

Label the outside of sealed kitchen bags with your initials, date, and sample station.

9.0 QUALITY CONTROL CHECKS

Do not use tubing or filters that have been exposed to potential contamination sources. Inspect tubing prior to sampling

10.0 DOCUMENTATION

Document decontamination date and personnel on field mobilization sheets.

APPENDIX B
METHOD SELECTION WORKSHEETS

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
METALS								
Aluminum	7429-90-5	Y	Soil	ID+Q	5.00E+01	2.70E+00	mg/Kg	SW-846 6010B
Antimony	7440-36-0	Y	Soil	ID+Q	2.70E-01	3.30E-01	mg/Kg	SW-846 6010B
Arsenic	7440-38-2	Y	Soil	ID+Q	1.80E+01	5.30E-01	mg/Kg	SW-846 6010B
Barium	7440-39-3	Y	Soil	ID+Q	3.30E+02	3.30E-01	mg/Kg	SW-846 6010B
Beryllium	7440-41-7	Y	Soil	ID+Q	1.00E+01	7.00E-02	mg/Kg	SW-846 6010B
Boron	7440-42-8	Y	Soil	ID+Q	5.00E-01	1.10E+00	mg/Kg	SW-846 6010B
Cadmium	7440-43-9	Y	Soil	ID+Q	3.60E-01	7.00E-02	mg/Kg	SW-846 6010B
Chromium	7440-47-3	Y	Soil	ID+Q	4.00E-01	1.30E-01	mg/Kg	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Soil	ID+Q	3.00E+01	6.70E-01	mg/Kg	SW-846 6010B
Cobalt	7440-48-4	Y	Soil	ID+Q	1.30E+01	1.30E-01	mg/Kg	SW-846 6010B
Copper	7440-50-8	Y	Soil	ID+Q	6.10E+01	1.30E-01	mg/Kg	SW-846 6010B
Iron	7439-89-6	Y	Soil	ID+Q	2.30E+04	1.30E+00	mg/Kg	SW-846 6010B
Lead	7439-92-1	Y	Soil	ID+Q	1.10E+01	2.00E-01	mg/Kg	SW-846 6010B
Lithium	7439-93-2	Y	Soil	ID+Q	2.00E+00	6.70E-01	mg/Kg	SW-846 6010B
Manganese	7439-96-5	Y	Soil	ID+Q	5.00E+02	2.00E-01	mg/Kg	SW-846 6010B
Mercury	7439-97-6	Y	Soil	ID+Q	1.00E-01	7.00E-03	mg/Kg	SW-846 7471A
Molybdenum	7439-98-7	Y	Soil	ID+Q	2.00E+00	4.00E-01	mg/Kg	SW-846 6010B
Nickel	7440-02-0	Y	Soil	ID+Q	3.00E+01	5.30E-01	mg/Kg	SW-846 6010B
Selenium	7782-49-2	Y	Soil	ID+Q	1.00E+00	4.40E-01	mg/Kg	SW-846 6010B
Silver	7440-22-4	Y	Soil	ID+Q	2.00E+00	1.30E-01	mg/Kg	SW-846 6010B
Strontium	7440-24-6	Y	Soil	ID+Q	3.07E+04	1.30E-01	mg/Kg	SW-846 6010B
Thallium	7791-12-0	Y	Soil	ID+Q	1.00E+00	2.70E-01	mg/Kg	SW-846 6010B
Tin	7440-31-5	Y	Soil	ID+Q	5.00E+01	1.30E+00	mg/Kg	SW-846 6010B
Titanium	7440-32-6	Y	Soil	ID+Q	1.00E+06	1.30E+00	mg/Kg	SW-846 6010B
Vanadium	7440-62-2	Y	Soil	ID+Q	2.00E+00	2.70E-01	mg/Kg	SW-846 6010B
Zinc	7440-66-6	Y	Soil	ID+Q	1.20E+02	2.70E-01	mg/Kg	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Soil	ID+Q	2.40E+00	8.00E-04	mg/Kg	SW-846 8081A
4,4'-DDE	72-55-9	Y	Soil	ID+Q	1.70E+00	1.30E-03	mg/Kg	SW-846 8081A
4,4'-DDT	50-29-3	Y	Soil	ID+Q	1.70E+00	1.30E-03	mg/Kg	SW-846 8081A
Aldrin	309-00-2	Y	Soil	ID+Q	2.90E-02	7.00E-04	mg/Kg	SW-846 8081A
alpha-BHC	319-84-6	Y	Soil	ID+Q	9.00E-02	7.00E-04	mg/Kg	SW-846 8081A
beta-BHC	319-85-7	Y	Soil	ID+Q	3.20E-01	1.30E-03	mg/Kg	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Soil	ID+Q	9.17E-01	7.00E-04	mg/Kg	SW-846 8081A
delta-BHC	319-86-8	Y	Soil	ID+Q	2.85E+00	7.00E-04	mg/Kg	SW-846 8081A

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Dieldrin	60-57-1	Y	Soil	ID+Q	3.20E-05	5.00E-04	mg/Kg	SW-846 8081A
Endosulfan I	959-98-8	Y	Soil	ID+Q	4.65E+01	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan II	33213-65-9	Y	Soil	ID+Q	2.72E+02	1.30E-03	mg/Kg	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Soil	ID+Q	3.85E+02	1.30E-03	mg/Kg	SW-846 8081A
Endrin	72-20-8	Y	Soil	ID+Q	8.69E+00	1.30E-03	mg/Kg	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Soil	ID+Q	1.94E+01	1.30E-03	mg/Kg	SW-846 8081A
Endrin ketone	53494-70-5	Y	Soil	ID+Q	1.86E+01	1.30E-03	mg/Kg	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Soil	ID+Q	4.40E-01	1.00E-03	mg/Kg	SW-846 8081A
gamma-Chlordane	57-74-9	Y	Soil	ID+Q	7.30E+00	1.30E-03	mg/Kg	SW-846 8081A
Heptachlor	76-44-8	Y	Soil	ID+Q	1.10E-01	7.00E-04	mg/Kg	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Soil	ID+Q	5.30E-02	1.30E-03	mg/Kg	SW-846 8081A
Methoxychlor	72-43-5	Y	Soil	ID+Q	2.69E+02	6.70E-03	mg/Kg	SW-846 8081A
Toxaphene	8001-35-2	Y	Soil	ID+Q	4.40E-01	6.67E-02	mg/Kg	SW-846 8081A
PCBs								
Aroclor-1016	12674-11-2	Y	Soil	ID+Q	3.93E+00	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1221	11104-28-2	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1232	11141-16-5	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1242	53469-21-9	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1248	12672-29-6	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1254	11097-69-1	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1260	11096-82-5	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Soil	ID+Q	3.00E+00	1.70E-03	mg/Kg	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Soil	ID+Q	8.10E+01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Soil	ID+Q	3.80E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Soil	ID+Q	8.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Soil	ID+Q	4.62E+02	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Soil	ID+Q	2.50E+00	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Soil	ID+Q	6.72E+00	1.70E-03	mg/Kg	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Soil	ID+Q	1.40E-03	7.00E-04	mg/Kg	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Soil	ID+Q	2.00E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Soil	ID+Q	5.20E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Soil	ID+Q	8.73E-02	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Soil	ID+Q	1.03E-02	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Soil	ID+Q	2.80E+02	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
1,2-Dichloroethane	107-06-2	Y	Soil	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Soil	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Soil	ID+Q	2.10E+01	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Soil	ID+Q	6.16E+01	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Soil	ID+Q	3.22E+00	1.70E-03	mg/Kg	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Soil	ID+Q	3.20E+00	1.70E-03	mg/Kg	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Soil	ID+Q	6.04E+00	1.70E-03	mg/Kg	SW-846 8260B
2-Butanone	78-93-3	Y	Soil	ID+Q	1.46E+03	1.70E-03	mg/Kg	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Soil	ID+Q	1.44E-01	3.30E-03	mg/Kg	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Soil	ID+Q	1.60E+02	1.70E-03	mg/Kg	SW-846 8260B
2-Hexanone	591-78-6	Y	Soil	ID+Q	5.60E+01	1.70E-03	mg/Kg	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Soil	ID+Q	2.47E+00	1.70E-03	mg/Kg	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Soil	ID+Q	2.47E+03	1.70E-03	mg/Kg	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Soil	ID+Q	2.47E+02	1.70E-03	mg/Kg	SW-846 8260B
Acetone	67-64-1	Y	Soil	ID+Q	2.14E+03	8.30E-03	mg/Kg	SW-846 8260B
Acrolein	107-02-8	Y	Soil	ID+Q	1.00E-01	8.30E-03	mg/Kg	SW-846 8260B
Acrylonitrile	107-13-1	Y	Soil	ID+Q	1.67E-01	8.30E-03	mg/Kg	SW-846 8260B
Benzene	71-43-2	Y	Soil	ID+Q	6.60E-01	1.70E-03	mg/Kg	SW-846 8260B
Bromobenzene	108-86-1	Y	Soil	ID+Q	7.30E+01	1.70E-03	mg/Kg	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Soil	ID+Q	1.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Bromoform	75-25-2	Y	Soil	ID+Q	3.16E+01	1.70E-03	mg/Kg	SW-846 8260B
Bromomethane	74-83-9	Y	Soil	ID+Q	3.90E+00	3.30E-03	mg/Kg	SW-846 8260B
Butanol	71-36-3	Y	Soil	ID+Q	2.63E+02	8.30E-03	mg/Kg	SW-846 8260B
Carbon disulfide	75-15-0	Y	Soil	ID+Q	6.79E+02	1.70E-03	mg/Kg	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Soil	ID+Q	2.40E-01	1.70E-03	mg/Kg	SW-846 8260B
Chlorobenzene	108-90-7	Y	Soil	ID+Q	4.00E+01	1.70E-03	mg/Kg	SW-846 8260B
Chloroethane	75-00-3	Y	Soil	ID+Q	3.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Chloroform	67-66-3	Y	Soil	ID+Q	2.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Chloromethane	74-87-3	Y	Soil	ID+Q	1.30E+00	1.70E-03	mg/Kg	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Soil	ID+Q	1.24E+01	1.70E-03	mg/Kg	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Soil	ID+Q	3.32E-01	1.70E-03	mg/Kg	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Soil	ID+Q	1.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Dibromomethane	74-95-3	Y	Soil	ID+Q	5.65E+01	1.70E-03	mg/Kg	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Soil	ID+Q	9.40E+01	1.70E-03	mg/Kg	SW-846 8260B
Ethylbenzene	100-41-4	Y	Soil	ID+Q	2.30E+02	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Hexachlorobutadiene	87-68-3	Y	Soil	ID+Q	6.20E+00	3.30E-03	mg/Kg	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Soil	ID+Q	3.70E+02	1.70E-03	mg/Kg	SW-846 8260B
Methyl acetate	79-20-9	Y	Soil	ID+Q	2.44E+03	3.30E-03	mg/Kg	SW-846 8260B
Methyl iodide	74-88-4	Y	Soil	ID+Q	5.68E+00	1.70E-03	mg/Kg	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
Methylene chloride	75-09-2	Y	Soil	ID+Q	6.54E-01	3.30E-03	mg/Kg	SW-846 8260B
Naphthalene	91-20-3	Y	Soil	ID+Q	1.20E+02	1.70E-03	mg/Kg	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
o-Xylene	95-47-6	Y	Soil	ID+Q	2.80E+02	1.70E-03	mg/Kg	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Soil	ID+Q	1.10E+02	1.70E-03	mg/Kg	SW-846 8260B
Styrene	100-42-5	Y	Soil	ID+Q	1.63E+02	1.70E-03	mg/Kg	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Soil	ID+Q	1.70E+01	1.70E-03	mg/Kg	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Soil	ID+Q	1.30E+02	1.70E-03	mg/Kg	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Soil	ID+Q	5.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Toluene	108-88-3	Y	Soil	ID+Q	2.00E+02	1.70E-03	mg/Kg	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Soil	ID+Q	2.45E+01	1.70E-03	mg/Kg	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Soil	ID+Q	1.79E+00	1.70E-03	mg/Kg	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Soil	ID+Q	1.70E-01	1.70E-03	mg/Kg	SW-846 8260B
Trichloroethene	79-01-6	Y	Soil	ID+Q	4.30E-02	1.70E-03	mg/Kg	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Soil	ID+Q	3.90E+02	1.70E-03	mg/Kg	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Soil	ID+Q	5.60E+03	1.70E-03	mg/Kg	SW-846 8260B
Vinyl acetate	108-05-4	Y	Soil	ID+Q	4.30E+02	1.70E-03	mg/Kg	SW-846 8260B
Vinyl chloride	75-01-4	Y	Soil	ID+Q	1.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Xylene (total)	1330-20-7	Y	Soil	ID+Q	2.10E+02	3.30E-03	mg/Kg	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Soil	ID+Q	6.10E-01	1.10E-01	mg/Kg	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Soil	ID+Q	4.00E+00	1.10E-01	mg/Kg	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Soil	ID+Q	1.00E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Soil	ID+Q	1.76E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Soil	ID+Q	1.62E+02	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Soil	ID+Q	4.68E+00	5.50E-01	mg/Kg	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Soil	ID+Q	2.66E-01	1.10E-01	mg/Kg	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Soil	ID+Q	2.40E-01	1.10E-01	mg/Kg	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Soil	ID+Q	3.90E+03	1.10E-01	mg/Kg	SW-846 8270C

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
2-Chlorophenol	95-57-8	Y	Soil	ID+Q	6.40E+01	1.10E-01	mg/Kg	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Soil	ID+Q	2.52E+02	2.20E-02	mg/Kg	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Soil	ID+Q	1.10E+00	5.50E-01	mg/Kg	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Soil	ID+Q	6.73E+00	1.10E-01	mg/Kg	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Soil	ID+Q	1.10E+00	2.20E-01	mg/Kg	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Soil	ID+Q	1.28E+00	5.50E-01	mg/Kg	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Soil	ID+Q	4.69E+00	5.50E-01	mg/Kg	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Soil	ID+Q	2.68E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Soil	ID+Q	2.26E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Soil	ID+Q	2.23E+01	1.10E-01	mg/Kg	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Soil	ID+Q	1.54E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Soil	ID+Q	2.84E+00	5.50E-01	mg/Kg	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Soil	ID+Q	4.99E+00	5.50E-01	mg/Kg	SW-846 8270C
Acenaphthene	83-32-9	Y	Soil	ID+Q	2.00E+01	2.20E-02	mg/Kg	SW-846 8270C
Acenaphthylene	208-96-8	Y	Soil	ID+Q	3.78E+03	2.20E-02	mg/Kg	SW-846 8270C
Acetophenone	98-86-2	Y	Soil	ID+Q	4.12E+02	1.10E-01	mg/Kg	SW-846 8270C
Aniline	62-53-3	Y	Soil	ID+Q	1.83E+01	1.10E-01	mg/Kg	SW-846 8270C
Anthracene	120-12-7	Y	Soil	ID+Q	1.77E+04	2.20E-02	mg/Kg	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Soil	ID+Q	1.25E+00	2.20E-01	mg/Kg	SW-846 8270C
Benzaldehyde	100-52-7	Y	Soil	ID+Q	2.40E+02	2.20E-01	mg/Kg	SW-846 8270C
Benzidine	92-87-5	Y	Soil	ID+Q	5.46E-04	6.70E-02	mg/Kg	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Soil	ID+Q	6.20E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Soil	ID+Q	6.20E-02	2.20E-02	mg/Kg	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Soil	ID+Q	6.20E-01	1.10E-01	mg/Kg	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Soil	ID+Q	1.78E+03	1.10E-01	mg/Kg	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Soil	ID+Q	6.20E+00	1.10E-01	mg/Kg	SW-846 8270C
Benzoic acid	65-85-0	Y	Soil	ID+Q	3.54E+02	5.50E-01	mg/Kg	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Soil	ID+Q	8.79E+02	1.10E-01	mg/Kg	SW-846 8270C
Biphenyl	92-52-4	Y	Soil	ID+Q	6.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Soil	ID+Q	5.88E-01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Soil	ID+Q	1.05E-01	1.05E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Soil	ID+Q	9.50E+00	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Soil	ID+Q	3.50E+01	2.20E-02	mg/Kg	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Soil	ID+Q	2.40E+02	1.10E-01	mg/Kg	SW-846 8270C
Caprolactam	105-60-2	Y	Soil	ID+Q	1.67E+02	2.20E-01	mg/Kg	SW-846 8270C

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Carbazole	86-74-8	Y	Soil	ID+Q	2.40E+01	1.10E-01	mg/Kg	SW-846 8270C
Chrysene	218-01-9	Y	Soil	ID+Q	6.20E+01	1.10E-01	mg/Kg	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Soil	ID+Q	6.20E-02	2.20E-02	mg/Kg	SW-846 8270C
Dibenzofuran	132-64-9	Y	Soil	ID+Q	1.50E+02	1.10E-01	mg/Kg	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Soil	ID+Q	1.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Soil	ID+Q	2.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Soil	ID+Q	2.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Soil	ID+Q	1.29E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluoranthene	206-44-0	Y	Soil	ID+Q	2.30E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluorene	86-73-7	Y	Soil	ID+Q	3.00E+01	2.20E-02	mg/Kg	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Soil	ID+Q	3.00E-01	1.10E-01	mg/Kg	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Soil	ID+Q	7.16E+00	1.10E-01	mg/Kg	SW-846 8270C
Hexachloroethane	67-72-1	Y	Soil	ID+Q	3.50E+01	1.10E-01	mg/Kg	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Soil	ID+Q	6.20E-01	1.10E-01	mg/Kg	SW-846 8270C
Isophorone	78-59-1	Y	Soil	ID+Q	1.50E+02	1.10E-01	mg/Kg	SW-846 8270C
Nitrobenzene	98-95-3	Y	Soil	ID+Q	4.39E+00	1.90E-02	mg/Kg	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Soil	ID+Q	1.84E-03	6.50E-02	mg/Kg	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Soil	ID+Q	1.76E-02	2.20E-02	mg/Kg	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Soil	ID+Q	2.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Soil	ID+Q	1.80E-03	1.30E-01	mg/Kg	SW-846 8270C
Phenanthrene	85-01-8	Y	Soil	ID+Q	1.71E+03	2.20E-02	mg/Kg	SW-846 8270C
Phenol	108-95-2	Y	Soil	ID+Q	3.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Pyrene	129-00-0	Y	Soil	ID+Q	1.70E+03	1.10E-01	mg/Kg	SW-846 8270C
Pyridine	110-86-1	Y	Soil	ID+Q	3.45E+00	1.10E-01	mg/Kg	SW-846 8270C

Notes:
NV - No value established

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
METALS								
Aluminum	7429-90-5	Y	Groundwater	ID+Q	2.40E+01	6.70E-02	mg/L	SW-846 6010B
Antimony	7440-36-0	Y	Groundwater	ID+Q	6.00E-03	6.00E-03	mg/L	SW-846 6010B
Arsenic	7440-38-2	Y	Groundwater	ID+Q	1.00E-02	1.00E-02	mg/L	SW-846 6010B
Barium	7440-39-3	Y	Groundwater	ID+Q	2.00E+00	3.00E-03	mg/L	SW-846 6010B
Beryllium	7440-41-7	Y	Groundwater	ID+Q	4.00E-03	2.00E-03	mg/L	SW-846 6010B
Boron	7440-42-8	Y	Groundwater	ID+Q	4.90E+00	3.33E-01	mg/L	SW-846 6010B
Cadmium	7440-43-9	Y	Groundwater	ID+Q	5.00E-03	2.00E-03	mg/L	SW-846 6010B
Chromium	7440-47-3	Y	Groundwater	ID+Q	1.00E-01	3.00E-03	mg/L	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Groundwater	ID+Q	4.96E-02	8.00E-03	mg/L	SW-846 6010B
Cobalt	7440-48-4	Y	Groundwater	ID+Q	1.50E+00	3.00E-03	mg/L	SW-846 6010B
Copper	7440-50-8	Y	Groundwater	ID+Q	3.60E-03	2.00E-03	mg/L	SW-846 6010B
Ferric Iron	MET-002	Y	Groundwater	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Iron	7439-89-6	Y	Groundwater	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Lead	7439-92-1	Y	Groundwater	ID+Q	5.30E-03	3.00E-03	mg/L	SW-846 6010B
Lithium	7439-93-2	Y	Groundwater	ID+Q	4.90E-01	1.70E-02	mg/L	SW-846 6010B
Manganese	7439-96-5	Y	Groundwater	ID+Q	1.20E+00	5.00E-03	mg/L	SW-846 6010B
Mercury	7439-97-6	Y	Groundwater	ID+Q	1.10E-03	2.00E-04	mg/L	SW-846 7470A
Molybdenum	7439-98-7	Y	Groundwater	ID+Q	1.20E-01	1.70E-02	mg/L	SW-846 6010B
Nickel	7440-02-0	Y	Groundwater	ID+Q	1.31E-02	2.00E-03	mg/L	SW-846 6010B
Selenium	7782-49-2	Y	Groundwater	ID+Q	5.00E-02	1.30E-02	mg/L	SW-846 6010B
Silver	7440-22-4	Y	Groundwater	ID+Q	1.20E-01	2.00E-03	mg/L	SW-846 6010B
Strontium	7440-24-6	Y	Groundwater	ID+Q	1.50E+01	1.70E-02	mg/L	SW-846 6010B
Thallium	7791-12-0	Y	Groundwater	ID+Q	2.00E-03	2.90E-03	mg/L	SW-846 6010B
Tin	7440-31-5	Y	Groundwater	ID+Q	1.50E+01	8.00E-03	mg/L	SW-846 6010B
Titanium	7440-32-6	Y	Groundwater	ID+Q	1.20E+04	3.30E-02	mg/L	SW-846 6010B
Vanadium	7440-62-2	Y	Groundwater	ID+Q	1.70E-01	7.00E-03	mg/L	SW-846 6010B
Zinc	7440-66-6	Y	Groundwater	ID+Q	8.42E-02	7.00E-03	mg/L	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Groundwater	ID+Q	2.50E-05	2.50E-05	mg/L	SW-846 8081A
4,4'-DDE	72-55-9	Y	Groundwater	ID+Q	1.40E-04	3.00E-05	mg/L	SW-846 8081A
4,4'-DDT	50-29-3	Y	Groundwater	ID+Q	1.00E-06	1.80E-05	mg/L	SW-846 8081A
Aldrin	309-00-2	Y	Groundwater	ID+Q	5.40E-05	2.00E-05	mg/L	SW-846 8081A
alpha-BHC	319-84-6	Y	Groundwater	ID+Q	1.50E-04	2.00E-05	mg/L	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Groundwater	ID+Q	2.60E-03	2.00E-05	mg/L	SW-846 8081A
beta-BHC	319-85-7	Y	Groundwater	ID+Q	5.10E-04	2.00E-05	mg/L	SW-846 8081A

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
delta-BHC	319-86-8	Y	Groundwater	ID+Q	5.10E-04	2.00E-05	mg/L	SW-846 8081A
Dieldrin	60-57-1	Y	Groundwater	ID+Q	2.00E-06	1.50E-05	mg/L	SW-846 8081A
Endosulfan I	959-98-8	Y	Groundwater	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endosulfan II	33213-65-9	Y	Groundwater	ID+Q	9.00E-06	2.40E-05	mg/L	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Groundwater	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endrin	72-20-8	Y	Groundwater	ID+Q	2.00E-06	2.50E-05	mg/L	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Groundwater	ID+Q	7.30E-03	3.00E-05	mg/L	SW-846 8081A
Endrin ketone	53494-70-5	Y	Groundwater	ID+Q	7.30E-03	3.00E-05	mg/L	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Groundwater	ID+Q	1.60E-05	1.60E-05	mg/L	SW-846 8081A
gamma-Chlordane	57-74-9	Y	Groundwater	ID+Q	2.60E-03	3.00E-05	mg/L	SW-846 8081A
Heptachlor	76-44-8	Y	Groundwater	ID+Q	4.00E-06	1.40E-05	mg/L	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Groundwater	ID+Q	3.60E-06	2.20E-05	mg/L	SW-846 8081A
Methoxychlor	72-43-5	Y	Groundwater	ID+Q	3.00E-05	3.00E-05	mg/L	SW-846 8081A
Toxaphene	8001-35-2	Y	Groundwater	ID+Q	2.00E-07	8.25E-04	mg/L	SW-846 8081A
PCBs								
Aroclor-1016	12674-11-2	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1221	11104-28-2	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1232	11141-16-5	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1242	53469-21-9	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1248	12672-29-6	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1254	11097-69-1	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1260	11096-82-5	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Groundwater	ID+Q	3.50E-02	1.70E-03	mg/L	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Groundwater	ID+Q	2.00E-01	1.70E-03	mg/L	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Groundwater	ID+Q	4.60E-03	1.70E-03	mg/L	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Groundwater	ID+Q	7.00E-03	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Groundwater	ID+Q	1.30E-04	7.00E-04	mg/L	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Groundwater	ID+Q	2.20E-02	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Groundwater	ID+Q	2.17E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Groundwater	ID+Q	2.00E-04	3.00E-04	mg/L	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Groundwater	ID+Q	5.00E-05	4.00E-04	mg/L	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Groundwater	ID+Q	5.91E-01	1.70E-03	mg/L	SW-846 8260B

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
1,2-Dichloroethane	107-06-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethene(Total)	540-59-0	Y	Groundwater	ID+Q	6.80E-01	3.30E-03	mg/L	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Groundwater	ID+Q	1.20E+00	1.70E-03	mg/L	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Groundwater	ID+Q	1.42E-01	1.70E-03	mg/L	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Groundwater	ID+Q	7.50E-02	1.70E-03	mg/L	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Groundwater	ID+Q	1.30E-02	1.70E-03	mg/L	SW-846 8260B
2-Butanone	78-93-3	Y	Groundwater	ID+Q	1.50E+01	1.70E-03	mg/L	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
2-Hexanone	591-78-6	Y	Groundwater	ID+Q	1.50E+00	1.70E-03	mg/L	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Groundwater	ID+Q	2.00E+00	1.70E-03	mg/L	SW-846 8260B
Acetone	67-64-1	Y	Groundwater	ID+Q	2.20E+01	8.30E-03	mg/L	SW-846 8260B
Acrolein	107-02-8	Y	Groundwater	ID+Q	1.00E-02	8.30E-03	mg/L	SW-846 8260B
Acrylonitrile	107-13-1	Y	Groundwater	ID+Q	1.70E-03	1.70E-03	mg/L	SW-846 8260B
Benzene	71-43-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Bromobenzene	108-86-1	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Groundwater	ID+Q	1.50E-02	1.70E-03	mg/L	SW-846 8260B
Bromoform	75-25-2	Y	Groundwater	ID+Q	1.20E-01	1.70E-03	mg/L	SW-846 8260B
Bromomethane	74-83-9	Y	Groundwater	ID+Q	3.40E-02	1.70E-03	mg/L	SW-846 8260B
Butanol	71-36-3	Y	Groundwater	ID+Q	2.40E+00	3.80E-02	mg/L	SW-846 8260B
Carbon disulfide	75-15-0	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Chlorobenzene	108-90-7	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
Chloroethane	75-00-3	Y	Groundwater	ID+Q	9.80E+00	1.70E-03	mg/L	SW-846 8260B
Chloroform	67-66-3	Y	Groundwater	ID+Q	2.40E-01	1.70E-03	mg/L	SW-846 8260B
Chloromethane	74-87-3	Y	Groundwater	ID+Q	7.00E-02	1.70E-03	mg/L	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Groundwater	ID+Q	7.00E-02	1.70E-03	mg/L	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Groundwater	ID+Q	1.70E-03	1.70E-03	mg/L	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Groundwater	ID+Q	1.10E-02	1.70E-03	mg/L	SW-846 8260B
Dibromomethane	74-95-3	Y	Groundwater	ID+Q	1.20E-01	1.70E-03	mg/L	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Groundwater	ID+Q	4.90E+00	1.70E-03	mg/L	SW-846 8260B
Ethylbenzene	100-41-4	Y	Groundwater	ID+Q	5.00E-01	1.70E-03	mg/L	SW-846 8260B

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Hexachlorobutadiene	87-68-3	Y	Groundwater	ID+Q	3.20E-04	4.00E-04	mg/L	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
Methyl acetate	79-20-9	Y	Groundwater	ID+Q	2.40E+01	1.70E-03	mg/L	SW-846 8260B
Methyl iodide	74-88-4	Y	Groundwater	ID+Q	3.40E-02	1.70E-03	mg/L	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Groundwater	ID+Q	1.20E+02	8.00E-03	mg/L	SW-846 8260B
Methylene chloride	75-09-2	Y	Groundwater	ID+Q	5.00E-03	3.30E-03	mg/L	SW-846 8260B
Naphthalene	91-20-3	Y	Groundwater	ID+Q	2.50E-01	1.70E-03	mg/L	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
o-Xylene	95-47-6	Y	Groundwater	ID+Q	1.00E+01	1.70E-03	mg/L	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
Styrene	100-42-5	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Groundwater	ID+Q	2.40E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Toluene	108-88-3	Y	Groundwater	ID+Q	9.50E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Groundwater	ID+Q	1.40E-01	1.70E-03	mg/L	SW-846 8260B
Trichloroethene	79-01-6	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Groundwater	ID+Q	7.30E+00	1.70E-03	mg/L	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Groundwater	ID+Q	7.30E+02	1.70E-03	mg/L	SW-846 8260B
Vinyl acetate	108-05-4	Y	Groundwater	ID+Q	2.40E+01	1.70E-03	mg/L	SW-846 8260B
Vinyl chloride	75-01-4	Y	Groundwater	ID+Q	2.00E-03	1.70E-03	mg/L	SW-846 8260B
Xylene (total)	1330-20-7	Y	Groundwater	ID+Q	8.50E-01	3.30E-03	mg/L	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Groundwater	ID+Q	1.10E-03	1.10E-03	mg/L	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Groundwater	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Groundwater	ID+Q	6.10E-02	3.30E-03	mg/L	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Groundwater	ID+Q	7.30E-02	3.30E-03	mg/L	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Groundwater	ID+Q	4.90E-01	1.00E-02	mg/L	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Groundwater	ID+Q	2.00E+00	3.30E-03	mg/L	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Groundwater	ID+Q	1.20E-01	3.30E-03	mg/L	SW-846 8270C

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
2-Methylnaphthalene	91-57-6	Y	Groundwater	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Groundwater	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Groundwater	ID+Q	4.90E-02	3.30E-03	mg/L	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Groundwater	ID+Q	2.00E-03	2.00E-03	mg/L	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Groundwater	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Groundwater	ID+Q	6.10E-05	6.00E-04	mg/L	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Groundwater	ID+Q	1.20E-01	3.30E-03	mg/L	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Groundwater	ID+Q	9.80E-02	3.30E-03	mg/L	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Groundwater	ID+Q	6.10E-05	6.00E-04	mg/L	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Groundwater	ID+Q	2.40E-02	1.67E-02	mg/L	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C
Acenaphthene	83-32-9	Y	Groundwater	ID+Q	4.04E-02	3.30E-03	mg/L	SW-846 8270C
Acenaphthylene	208-96-8	Y	Groundwater	ID+Q	1.50E+00	3.30E-03	mg/L	SW-846 8270C
Acetophenone	98-86-2	Y	Groundwater	ID+Q	2.40E+00	3.30E-03	mg/L	SW-846 8270C
Aniline	62-53-3	Y	Groundwater	ID+Q	1.60E-01	3.30E-03	mg/L	SW-846 8270C
Anthracene	120-12-7	Y	Groundwater	ID+Q	1.80E-04	6.00E-04	mg/L	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Groundwater	ID+Q	3.00E-03	3.00E-03	mg/L	SW-846 8270C
Benzaldehyde	100-52-7	Y	Groundwater	ID+Q	2.40E+00	6.70E-03	mg/L	SW-846 8270C
Benzidine	92-87-5	Y	Groundwater	ID+Q	4.00E-06	1.08E-02	mg/L	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Groundwater	ID+Q	2.00E-04	2.00E-04	mg/L	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Groundwater	ID+Q	7.30E-01	3.30E-03	mg/L	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Groundwater	ID+Q	1.30E-02	3.30E-03	mg/L	SW-846 8270C
Benzoic acid	65-85-0	Y	Groundwater	ID+Q	9.80E+01	1.67E-02	mg/L	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Groundwater	ID+Q	7.30E+00	3.30E-03	mg/L	SW-846 8270C
Biphenyl	92-52-4	Y	Groundwater	ID+Q	1.20E+00	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Groundwater	ID+Q	1.30E-02	3.30E-03	mg/L	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Groundwater	ID+Q	6.00E-03	3.30E-03	mg/L	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Groundwater	ID+Q	1.47E-01	3.30E-03	mg/L	SW-846 8270C
Caprolactam	105-60-2	Y	Groundwater	ID+Q	1.20E+01	3.30E-03	mg/L	SW-846 8270C
Carbazole	86-74-8	Y	Groundwater	ID+Q	4.60E-02	3.30E-03	mg/L	SW-846 8270C
Chrysene	218-01-9	Y	Groundwater	ID+Q	1.30E-01	3.30E-03	mg/L	SW-846 8270C

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Dibenz(a,h)anthracene	53-70-3	Y	Groundwater	ID+Q	2.00E-04	5.00E-04	mg/L	SW-846 8270C
Dibenzofuran	132-64-9	Y	Groundwater	ID+Q	6.50E-02	3.30E-03	mg/L	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Groundwater	ID+Q	8.84E-01	3.30E-03	mg/L	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Groundwater	ID+Q	5.80E-01	3.30E-03	mg/L	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Groundwater	ID+Q	4.90E-01	3.30E-03	mg/L	SW-846 8270C
Fluoranthene	206-44-0	Y	Groundwater	ID+Q	2.96E-03	7.00E-04	mg/L	SW-846 8270C
Fluorene	86-73-7	Y	Groundwater	ID+Q	5.00E-02	3.30E-03	mg/L	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Groundwater	ID+Q	1.00E-03	1.00E-03	mg/L	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Groundwater	ID+Q	7.00E-05	2.80E-03	mg/L	SW-846 8270C
Hexachloroethane	67-72-1	Y	Groundwater	ID+Q	9.40E-03	2.20E-03	mg/L	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Isophorone	78-59-1	Y	Groundwater	ID+Q	9.60E-01	3.30E-03	mg/L	SW-846 8270C
Nitrobenzene	98-95-3	Y	Groundwater	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Groundwater	ID+Q	1.80E-05	1.80E-03	mg/L	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Groundwater	ID+Q	1.30E-04	4.00E-04	mg/L	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Groundwater	ID+Q	1.90E-01	3.30E-03	mg/L	SW-846 8270C
o-Cresol	95-48-7	Y	Groundwater	ID+Q	1.02E+00	3.30E-03	mg/L	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Groundwater	ID+Q	1.00E-03	9.60E-03	mg/L	SW-846 8270C
Phenanthrene	85-01-8	Y	Groundwater	ID+Q	4.60E-03	7.00E-04	mg/L	SW-846 8270C
Phenol	108-95-2	Y	Groundwater	ID+Q	5.50E+00	3.30E-03	mg/L	SW-846 8270C
Pyrene	129-00-0	Y	Groundwater	ID+Q	2.40E-04	4.00E-04	mg/L	SW-846 8270C
Pyridine	110-86-1	Y	Groundwater	ID+Q	2.40E-02	6.70E-03	mg/L	SW-846 8270C

Notes:
NV - No value established

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
METALS								
Aluminum	7429-90-5	Y	Surface Water	ID+Q	NV	6.70E-02	mg/L	SW-846 6010B
Antimony	7440-36-0	Y	Surface Water	ID+Q	5.00E-01	2.00E-02	mg/L	SW-846 6010B
Arsenic	7440-38-2	Y	Surface Water	ID+Q	7.80E-02	1.30E-02	mg/L	SW-846 6010B
Barium	7440-39-3	Y	Surface Water	ID+Q	NV	3.00E-03	mg/L	SW-846 6010B
Beryllium	7440-41-7	Y	Surface Water	ID+Q	NV	2.00E-03	mg/L	SW-846 6010B
Boron	7440-42-8	Y	Surface Water	ID+Q	NV	3.33E-01	mg/L	SW-846 6010B
Cadmium	7440-43-9	Y	Surface Water	ID+Q	1.00E-02	2.00E-03	mg/L	SW-846 6010B
Chromium	7440-47-3	Y	Surface Water	ID+Q	2.22E+00	3.00E-03	mg/L	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Surface Water	ID+Q	4.96E-02	8.00E-03	mg/L	SW-846 6010B
Cobalt	7440-48-4	Y	Surface Water	ID+Q	NV	3.00E-03	mg/L	SW-846 6010B
Copper	7440-50-8	Y	Surface Water	ID+Q	3.60E-03	2.00E-03	mg/L	SW-846 6010B
Ferric Iron	MET-002	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Iron	7439-89-6	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Lead	7439-92-1	Y	Surface Water	ID+Q	5.30E-03	3.00E-03	mg/L	SW-846 6010B
Lithium	7439-93-2	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Manganese	7439-96-5	Y	Surface Water	ID+Q	1.00E-01	5.00E-03	mg/L	SW-846 6010B
Mercury	7439-97-6	Y	Surface Water	ID+Q	2.50E-05	2.00E-04	mg/L	SW-846 7470A
Molybdenum	7439-98-7	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Nickel	7440-02-0	Y	Surface Water	ID+Q	1.31E-02	2.00E-03	mg/L	SW-846 6010B
Selenium	7782-49-2	Y	Surface Water	ID+Q	1.36E-01	1.30E-02	mg/L	SW-846 6010B
Silver	7440-22-4	Y	Surface Water	ID+Q	3.65E+01	2.00E-03	mg/L	SW-846 6010B
Strontium	7440-24-6	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Thallium	7440-28-0	Y	Surface Water	ID+Q	4.70E-04	3.00E-03	mg/L	SW-846 6010B
Tin	7440-31-5	Y	Surface Water	ID+Q	NV	8.00E-03	mg/L	SW-846 6010B
Titanium	7440-32-6	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Vanadium	7440-62-2	Y	Surface Water	ID+Q	NV	7.00E-03	mg/L	SW-846 6010B
Zinc	7440-66-6	Y	Surface Water	ID+Q	8.42E-02	7.00E-03	mg/L	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Surface Water	ID+Q	7.00E-06	7.00E-06	mg/L	SW-846 8081A
4,4'-DDE	72-55-9	Y	Surface Water	ID+Q	5.00E-06	1.70E-05	mg/L	SW-846 8081A

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
4,4'-DDT	50-29-3	Y	Surface Water	ID+Q	1.00E-06	1.80E-05	mg/L	SW-846 8081A
Aldrin	309-00-2	Y	Surface Water	ID+Q	1.30E-04	2.00E-05	mg/L	SW-846 8081A
alpha-BHC	319-84-6	Y	Surface Water	ID+Q	2.80E-06	7.00E-06	mg/L	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Surface Water	ID+Q	2.13E-05	2.00E-05	mg/L	SW-846 8081A
beta-BHC	319-85-7	Y	Surface Water	ID+Q	NV	2.00E-05	mg/L	SW-846 8081A
delta-BHC	319-86-8	Y	Surface Water	ID+Q	NV	2.00E-05	mg/L	SW-846 8081A
Dieldrin	60-57-1	Y	Surface Water	ID+Q	2.00E-06	1.50E-05	mg/L	SW-846 8081A
Endosulfan I	959-98-8	Y	Surface Water	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endosulfan II	33213-65-9	Y	Surface Water	ID+Q	9.00E-06	2.40E-05	mg/L	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Surface Water	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endrin	72-20-8	Y	Surface Water	ID+Q	2.00E-06	2.50E-05	mg/L	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Surface Water	ID+Q	3.00E-04	3.00E-05	mg/L	SW-846 8081A
Endrin ketone	53494-70-5	Y	Surface Water	ID+Q	NV	3.00E-05	mg/L	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Surface Water	ID+Q	1.60E-05	1.60E-05	mg/L	SW-846 8081A
gamma-Chlordane	5103-74-2	Y	Surface Water	ID+Q	NV	3.00E-05	mg/L	SW-846 8081A
Heptachlor	76-44-8	Y	Surface Water	ID+Q	1.77E-06	1.40E-05	mg/L	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Surface Water	ID+Q	3.60E-06	2.20E-05	mg/L	SW-846 8081A
Methoxychlor	72-43-5	Y	Surface Water	ID+Q	3.00E-05	3.00E-05	mg/L	SW-846 8081A
Toxaphene	8001-35-2	Y	Surface Water	ID+Q	2.00E-07	8.25E-04	mg/L	SW-846 8081A
PCBs	1336-36-3	Y	Surface Water	ID+Q	8.85E-07	6.70E-04	mg/L	SW-846 8081A
Aroclor-1016	12674-11-2	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1221	11104-28-2	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1232	11141-16-5	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1242	53469-21-9	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1248	12672-29-6	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1254	11097-69-1	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1260	11096-82-5	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Surface Water	ID+Q	3.10E+00	1.70E-03	mg/L	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Surface Water	ID+Q	4.00E-02	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
1,1,2-Trichloroethane	79-00-5	Y	Surface Water	ID+Q	5.50E-01	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Surface Water	ID+Q	2.50E+01	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Surface Water	ID+Q	2.20E-02	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Surface Water	ID+Q	2.17E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Surface Water	ID+Q	5.91E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethane	107-06-2	Y	Surface Water	ID+Q	4.93E-02	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethene(Total)	540-59-0	Y	Surface Water	ID+Q	6.80E-01	3.30E-03	mg/L	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Surface Water	ID+Q	1.50E-01	1.70E-03	mg/L	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Surface Water	ID+Q	1.42E-01	1.70E-03	mg/L	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Surface Water	ID+Q	1.50E-01	1.70E-03	mg/L	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Surface Water	ID+Q	9.90E-02	1.70E-03	mg/L	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Butanone	78-93-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Hexanone	591-78-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Surface Water	ID+Q	1.23E+02	1.70E-03	mg/L	SW-846 8260B
Acetone	67-64-1	Y	Surface Water	ID+Q	5.64E+02	8.30E-03	mg/L	SW-846 8260B
Acrolein	107-02-8	Y	Surface Water	ID+Q	1.00E-02	8.30E-03	mg/L	SW-846 8260B
Acrylonitrile	107-13-1	Y	Surface Water	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8260B
Benzene	71-43-2	Y	Surface Water	ID+Q	7.08E-02	1.70E-03	mg/L	SW-846 8260B
Bromobenzene	108-86-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Bromoform	75-25-2	Y	Surface Water	ID+Q	1.22E+00	1.70E-03	mg/L	SW-846 8260B
Bromomethane	74-83-9	Y	Surface Water	ID+Q	1.20E+00	1.70E-03	mg/L	SW-846 8260B
Butanol	71-36-3	Y	Surface Water	ID+Q	NV	3.80E-02	mg/L	SW-846 8260B
Carbon disulfide	75-15-0	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Surface Water	ID+Q	5.60E-03	1.70E-03	mg/L	SW-846 8260B
Chlorobenzene	108-90-7	Y	Surface Water	ID+Q	1.05E-01	1.70E-03	mg/L	SW-846 8260B
Chloroethane	75-00-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Chloroform	67-66-3	Y	Surface Water	ID+Q	8.61E-01	1.70E-03	mg/L	SW-846 8260B
Chloromethane	74-87-3	Y	Surface Water	ID+Q	2.70E+01	1.70E-03	mg/L	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Surface Water	ID+Q	1.07E-01	1.70E-03	mg/L	SW-846 8260B
Cyclohexane	110-82-7	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Surface Water	ID+Q	4.77E-02	1.70E-03	mg/L	SW-846 8260B
Dibromomethane	74-95-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Ethylbenzene	100-41-4	Y	Surface Water	ID+Q	5.00E-01	1.70E-03	mg/L	SW-846 8260B
Hexachlorobutadiene	87-68-3	Y	Surface Water	ID+Q	3.20E-04	4.00E-04	mg/L	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methyl acetate	79-20-9	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methyl iodide	74-88-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Surface Water	ID+Q	NV	8.00E-03	mg/L	SW-846 8260B
Methylene chloride	75-09-2	Y	Surface Water	ID+Q	5.90E+00	3.30E-03	mg/L	SW-846 8260B
Naphthalene	91-20-3	Y	Surface Water	ID+Q	2.50E-01	1.70E-03	mg/L	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
o-Xylene	95-47-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Styrene	100-42-5	Y	Surface Water	ID+Q	9.10E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Surface Water	ID+Q	1.45E+00	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Toluene	108-88-3	Y	Surface Water	ID+Q	9.50E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Surface Water	ID+Q	1.07E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Trichloroethene	79-01-6	Y	Surface Water	ID+Q	1.94E+00	1.70E-03	mg/L	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Vinyl acetate	108-05-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Vinyl chloride	75-01-4	Y	Surface Water	ID+Q	2.77E-01	1.70E-03	mg/L	SW-846 8260B
Xylene (total)	1330-20-7	Y	Surface Water	ID+Q	8.50E-01	3.30E-03	mg/L	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Surface Water	ID+Q	2.00E-03	2.00E-03	mg/L	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Surface Water	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Surface Water	ID+Q	2.40E-03	2.40E-03	mg/L	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Surface Water	ID+Q	2.90E-01	3.30E-03	mg/L	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Surface Water	ID+Q	8.50E-01	1.00E-02	mg/L	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Surface Water	ID+Q	1.33E+00	1.67E-02	mg/L	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Surface Water	ID+Q	3.40E-02	3.30E-03	mg/L	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Surface Water	ID+Q	1.60E+00	3.30E-03	mg/L	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Surface Water	ID+Q	1.50E-01	3.30E-03	mg/L	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Surface Water	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Surface Water	ID+Q	2.94E+00	3.30E-03	mg/L	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Surface Water	ID+Q	2.80E-04	5.00E-04	mg/L	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes			Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)		ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
4-Nitroaniline	100-01-6	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Surface Water	ID+Q	7.17E-01	1.67E-02	mg/L	SW-846 8270C
Acenaphthene	83-32-9	Y	Surface Water	ID+Q	4.04E-02	3.30E-03	mg/L	SW-846 8270C
Acenaphthylene	208-96-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Acetophenone	98-86-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Aniline	62-53-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Anthracene	120-12-7	Y	Surface Water	ID+Q	1.80E-04	6.00E-04	mg/L	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Surface Water	ID+Q	NV	6.70E-03	mg/L	SW-846 8270C
Benzaldehyde	100-52-7	Y	Surface Water	ID+Q	NV	6.70E-03	mg/L	SW-846 8270C
Benzidine	92-87-5	Y	Surface Water	ID+Q	NV	1.33E-02	mg/L	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzoic acid	65-85-0	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Biphenyl	92-52-4	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Surface Water	ID+Q	1.47E-01	3.30E-03	mg/L	SW-846 8270C
Caprolactam	105-60-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Carbazole	86-74-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Chrysene	218-01-9	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Dibenzofuran	132-64-9	Y	Surface Water	ID+Q	6.50E-02	3.30E-03	mg/L	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Surface Water	ID+Q	8.84E-01	3.30E-03	mg/L	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Surface Water	ID+Q	5.80E-01	3.30E-03	mg/L	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Surface Water	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8270C

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Di-n-octyl phthalate	117-84-0	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Fluoranthene	206-44-0	Y	Surface Water	ID+Q	2.96E-03	7.00E-04	mg/L	SW-846 8270C
Fluorene	86-73-7	Y	Surface Water	ID+Q	5.00E-02	3.30E-03	mg/L	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Surface Water	ID+Q	7.00E-05	2.80E-03	mg/L	SW-846 8270C
Hexachloroethane	67-72-1	Y	Surface Water	ID+Q	9.40E-03	2.20E-03	mg/L	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Isophorone	78-59-1	Y	Surface Water	ID+Q	1.29E+00	3.30E-03	mg/L	SW-846 8270C
Nitrobenzene	98-95-3	Y	Surface Water	ID+Q	6.68E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Surface Water	ID+Q	3.00E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Surface Water	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Surface Water	ID+Q	3.30E+02	3.30E-03	mg/L	SW-846 8270C
o-Cresol	95-48-7	Y	Surface Water	ID+Q	1.02E+00	3.30E-03	mg/L	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Surface Water	ID+Q	9.60E-03	9.60E-03	mg/L	SW-846 8270C
Phenanthrene	85-01-8	Y	Surface Water	ID+Q	4.60E-03	7.00E-04	mg/L	SW-846 8270C
Phenol	108-95-2	Y	Surface Water	ID+Q	5.50E+00	3.30E-03	mg/L	SW-846 8270C
Pyrene	129-00-0	Y	Surface Water	ID+Q	2.40E-04	4.00E-04	mg/L	SW-846 8270C
Pyridine	110-86-1	Y	Surface Water	ID+Q	8.89E+00	6.70E-03	mg/L	SW-846 8270C

Notes:

NV - No value established

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
METALS								
Aluminum	7429-90-5	Y	Sediment	ID+Q	1.53E+05	2.70E+00	mg/Kg	SW-846 6010B
Antimony	7440-36-0	Y	Sediment	ID+Q	8.32E+01	6.70E-01	mg/Kg	SW-846 6010B
Arsenic	7440-38-2	Y	Sediment	ID+Q	8.20E+00	5.30E-01	mg/Kg	SW-846 6010B
Barium	7440-39-3	Y	Sediment	ID+Q	8.00E+03	1.30E-01	mg/Kg	SW-846 6010B
Beryllium	7440-41-7	Y	Sediment	ID+Q	2.66E+01	7.00E-02	mg/Kg	SW-846 6010B
Boron	7440-42-8	Y	Sediment	ID+Q	1.07E+05	1.10E+00	mg/Kg	SW-846 6010B
Cadmium	7440-43-9	Y	Sediment	ID+Q	1.20E+00	7.00E-02	mg/Kg	SW-846 6010B
Chromium	7440-47-3	Y	Sediment	ID+Q	8.10E+01	1.30E-01	mg/Kg	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Sediment	ID+Q	1.36E+02	6.70E-01	mg/Kg	SW-846 6010B
Cobalt	7440-48-4	Y	Sediment	ID+Q	3.20E+04	1.30E-01	mg/Kg	SW-846 6010B
Copper	7440-50-8	Y	Sediment	ID+Q	3.40E+01	1.30E-01	mg/Kg	SW-846 6010B
Iron	7439-89-6	Y	Sediment	ID+Q	NV	1.30E+00	mg/Kg	SW-846 6010B
Lead	7439-92-1	Y	Sediment	ID+Q	4.67E+01	2.00E-01	mg/Kg	SW-846 6010B
Lithium	7439-93-2	Y	Sediment	ID+Q	1.07E+04	6.70E-01	mg/Kg	SW-846 6010B
Manganese	7439-96-5	Y	Sediment	ID+Q	1.40E+04	2.00E-01	mg/Kg	SW-846 6010B
Mercury	7439-97-6	Y	Sediment	ID+Q	1.50E-01	7.00E-03	mg/Kg	SW-846 7471A
Molybdenum	7439-98-7	Y	Sediment	ID+Q	1.84E+03	4.00E-01	mg/Kg	SW-846 6010B
Nickel	7440-02-0	Y	Sediment	ID+Q	2.09E+01	5.30E-01	mg/Kg	SW-846 6010B
Selenium	7782-49-2	Y	Sediment	ID+Q	2.66E+03	4.40E-01	mg/Kg	SW-846 6010B
Silver	7440-22-4	Y	Sediment	ID+Q	1.00E+00	1.30E-01	mg/Kg	SW-846 6010B
Strontium	7440-24-6	Y	Sediment	ID+Q	1.52E+05	1.30E-01	mg/Kg	SW-846 6010B
Thallium	7440-28-0	Y	Sediment	ID+Q	NV	2.70E-01	mg/Kg	SW-846 6010B
Tin	7440-31-5	Y	Sediment	ID+Q	9.19E+04	1.30E+00	mg/Kg	SW-846 6010B
Titanium	7440-32-6	Y	Sediment	ID+Q	1.00E+06	1.30E+00	mg/Kg	SW-846 6010B
Vanadium	7440-62-2	Y	Sediment	ID+Q	3.29E+02	2.70E-01	mg/Kg	SW-846 6010B
Zinc	7440-66-6	Y	Sediment	ID+Q	1.50E+02	2.70E-01	mg/Kg	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Sediment	ID+Q	1.22E-03	1.20E-03	mg/Kg	SW-846 8081A
4,4'-DDE	72-55-9	Y	Sediment	ID+Q	2.07E-03	1.30E-03	mg/Kg	SW-846 8081A
4,4'-DDT	50-29-3	Y	Sediment	ID+Q	1.19E-03	1.10E-03	mg/Kg	SW-846 8081A
Aldrin	309-00-2	Y	Sediment	ID+Q	8.36E-01	7.00E-04	mg/Kg	SW-846 8081A
alpha-BHC	319-84-6	Y	Sediment	ID+Q	4.05E+00	7.00E-04	mg/Kg	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Sediment	ID+Q	4.06E+01	7.00E-04	mg/Kg	SW-846 8081A
beta-BHC	319-85-7	Y	Sediment	ID+Q	1.42E+01	1.30E-03	mg/Kg	SW-846 8081A
delta-BHC	319-86-8	Y	Sediment	ID+Q	1.42E+01	7.00E-04	mg/Kg	SW-846 8081A

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Dieldrin	60-57-1	Y	Sediment	ID+Q	7.15E-04	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan I	959-98-8	Y	Sediment	ID+Q	2.90E-03	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan II	33213-65-9	Y	Sediment	ID+Q	1.40E-02	1.30E-03	mg/Kg	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Sediment	ID+Q	9.19E+02	1.30E-03	mg/Kg	SW-846 8081A
Endrin	72-20-8	Y	Sediment	ID+Q	3.50E-03	1.30E-03	mg/Kg	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Sediment	ID+Q	4.59E+01	1.30E-03	mg/Kg	SW-846 8081A
Endrin ketone	53494-70-5	Y	Sediment	ID+Q	4.59E+01	1.30E-03	mg/Kg	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Sediment	ID+Q	3.20E-04	5.00E-04	mg/Kg	SW-846 8081A
gamma-Chlordane	5103-74-2	Y	Sediment	ID+Q	NV	1.30E-03	mg/Kg	SW-846 8081A
Heptachlor	76-44-8	Y	Sediment	ID+Q	3.16E+00	7.00E-04	mg/Kg	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Sediment	ID+Q	1.56E+00	1.30E-03	mg/Kg	SW-846 8081A
Methoxychlor	72-43-5	Y	Sediment	ID+Q	1.90E-02	6.70E-03	mg/Kg	SW-846 8081A
Toxaphene	8001-35-2	Y	Sediment	ID+Q	2.80E-02	2.80E-02	mg/Kg	SW-846 8081A
PCBs	1336-36-3	Y	Sediment	ID+Q	2.27E-02	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1016	12674-11-2	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1221	11104-28-2	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1232	11141-16-5	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1242	53469-21-9	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1248	12672-29-6	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1254	11097-69-1	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1260	11096-82-5	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Sediment	ID+Q	2.10E+03	1.70E-03	mg/Kg	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Sediment	ID+Q	1.70E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Sediment	ID+Q	9.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Sediment	ID+Q	9.56E+02	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Sediment	ID+Q	7.79E+00	7.00E-04	mg/Kg	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Sediment	ID+Q	9.20E+00	1.70E-03	mg/Kg	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Sediment	ID+Q	1.01E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Sediment	ID+Q	2.72E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Sediment	ID+Q	3.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichloroethane	107-06-2	Y	Sediment	ID+Q	5.99E+02	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
1,2-Dichloroethene(Total)	540-59-0	Y	Sediment	ID+Q	NV	3.30E-03	mg/Kg	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Sediment	ID+Q	8.01E+02	1.70E-03	mg/Kg	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Sediment	ID+Q	1.70E+00	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Sediment	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Sediment	ID+Q	8.01E+02	1.70E-03	mg/Kg	SW-846 8260B
2-Butanone	78-93-3	Y	Sediment	ID+Q	4.41E+05	1.70E-03	mg/Kg	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Sediment	ID+Q	4.95E+01	3.30E-03	mg/Kg	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Sediment	ID+Q	3.06E+03	1.70E-03	mg/Kg	SW-846 8260B
2-Hexanone	591-78-6	Y	Sediment	ID+Q	4.41E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Sediment	ID+Q	5.88E+04	1.70E-03	mg/Kg	SW-846 8260B
Acetone	67-64-1	Y	Sediment	ID+Q	6.61E+05	8.30E-03	mg/Kg	SW-846 8260B
Acrolein	107-02-8	Y	Sediment	ID+Q	3.67E+02	8.30E-03	mg/Kg	SW-846 8260B
Acrylonitrile	107-13-1	Y	Sediment	ID+Q	1.01E+02	8.30E-03	mg/Kg	SW-846 8260B
Benzene	71-43-2	Y	Sediment	ID+Q	5.70E-02	1.70E-03	mg/Kg	SW-846 8260B
Bromobenzene	108-86-1	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Sediment	ID+Q	8.79E+02	1.70E-03	mg/Kg	SW-846 8260B
Bromoform	75-25-2	Y	Sediment	ID+Q	6.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Bromomethane	74-83-9	Y	Sediment	ID+Q	1.03E+03	3.30E-03	mg/Kg	SW-846 8260B
Butanol	71-36-3	Y	Sediment	ID+Q	7.35E+04	8.30E-03	mg/Kg	SW-846 8260B
Carbon disulfide	75-15-0	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Sediment	ID+Q	1.20E+00	1.70E-03	mg/Kg	SW-846 8260B
Chlorobenzene	108-90-7	Y	Sediment	ID+Q	8.20E-01	1.70E-03	mg/Kg	SW-846 8260B
Chloroethane	75-00-3	Y	Sediment	ID+Q	2.94E+05	1.70E-03	mg/Kg	SW-846 8260B
Chloroform	67-66-3	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
Chloromethane	74-87-3	Y	Sediment	ID+Q	4.19E+03	1.70E-03	mg/Kg	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Sediment	ID+Q	7.35E+01	1.70E-03	mg/Kg	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Sediment	ID+Q	6.49E+02	1.70E-03	mg/Kg	SW-846 8260B
Dibromomethane	74-95-3	Y	Sediment	ID+Q	7.27E+03	1.70E-03	mg/Kg	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Sediment	ID+Q	1.47E+05	1.70E-03	mg/Kg	SW-846 8260B
Ethylbenzene	100-41-4	Y	Sediment	ID+Q	3.60E+00	1.70E-03	mg/Kg	SW-846 8260B
Hexachlorobutadiene	87-68-3	Y	Sediment	ID+Q	3.06E+01	3.30E-03	mg/Kg	SW-846 8260B

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Isopropylbenzene (Cumene)	98-82-8	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
Methyl acetate	79-20-9	Y	Sediment	ID+Q	7.35E+05	3.30E-03	mg/Kg	SW-846 8260B
Methyl iodide	74-88-4	Y	Sediment	ID+Q	1.03E+03	1.70E-03	mg/Kg	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
Methylene chloride	75-09-2	Y	Sediment	ID+Q	7.27E+03	3.30E-03	mg/Kg	SW-846 8260B
Naphthalene	91-20-3	Y	Sediment	ID+Q	1.60E-01	1.70E-03	mg/Kg	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Sediment	ID+Q	6.12E+03	1.70E-03	mg/Kg	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
o-Xylene	95-47-6	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
Styrene	100-42-5	Y	Sediment	ID+Q	1.47E+05	1.70E-03	mg/Kg	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Sediment	ID+Q	5.30E-01	1.70E-03	mg/Kg	SW-846 8260B
Toluene	108-88-3	Y	Sediment	ID+Q	6.70E-01	1.70E-03	mg/Kg	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Sediment	ID+Q	NV	1.70E-03	mg/Kg	SW-846 8260B
Trichloroethene	79-01-6	Y	Sediment	ID+Q	1.60E+00	1.70E-03	mg/Kg	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Sediment	ID+Q	2.20E+05	1.70E-03	mg/Kg	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
Vinyl acetate	108-05-4	Y	Sediment	ID+Q	7.35E+05	1.70E-03	mg/Kg	SW-846 8260B
Vinyl chloride	75-01-4	Y	Sediment	ID+Q	3.63E+01	1.70E-03	mg/Kg	SW-846 8260B
Xylene (total)	1330-20-7	Y	Sediment	ID+Q	1.47E+05	3.30E-03	mg/Kg	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Sediment	ID+Q	1.78E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Sediment	ID+Q	1.53E+04	1.10E-01	mg/Kg	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Sediment	ID+Q	1.29E+03	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Sediment	ID+Q	4.59E+02	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Sediment	ID+Q	3.06E+03	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Sediment	ID+Q	2.09E+01	1.10E-01	mg/Kg	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Sediment	ID+Q	2.09E+01	1.10E-01	mg/Kg	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Sediment	ID+Q	9.90E+03	1.10E-01	mg/Kg	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Sediment	ID+Q	3.67E+03	1.10E-01	mg/Kg	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Sediment	ID+Q	7.00E-02	2.20E-02	mg/Kg	SW-846 8270C

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
2-Nitroaniline	88-74-4	Y	Sediment	ID+Q	4.59E+01	5.50E-01	mg/Kg	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Sediment	ID+Q	3.06E+02	1.10E-01	mg/Kg	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Sediment	ID+Q	3.16E+01	2.20E-01	mg/Kg	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Sediment	ID+Q	4.59E+01	5.50E-01	mg/Kg	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Sediment	ID+Q	9.47E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Sediment	ID+Q	7.65E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Sediment	ID+Q	6.12E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Sediment	ID+Q	9.47E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Sediment	ID+Q	3.74E+02	5.50E-01	mg/Kg	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
Acenaphthene	83-32-9	Y	Sediment	ID+Q	1.60E-02	1.60E-02	mg/Kg	SW-846 8270C
Acenaphthylene	208-96-8	Y	Sediment	ID+Q	4.40E-02	2.20E-02	mg/Kg	SW-846 8270C
Acetophenone	98-86-2	Y	Sediment	ID+Q	1.53E+04	1.10E-01	mg/Kg	SW-846 8270C
Aniline	62-53-3	Y	Sediment	ID+Q	1.07E+03	1.10E-01	mg/Kg	SW-846 8270C
Anthracene	120-12-7	Y	Sediment	ID+Q	8.53E-02	2.20E-02	mg/Kg	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Sediment	ID+Q	6.40E+01	2.20E-01	mg/Kg	SW-846 8270C
Benzaldehyde	100-52-7	Y	Sediment	ID+Q	7.35E+04	2.20E-01	mg/Kg	SW-846 8270C
Benzidine	92-87-5	Y	Sediment	ID+Q	6.18E-02	6.70E-02	mg/Kg	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Sediment	ID+Q	2.61E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Sediment	ID+Q	4.30E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Sediment	ID+Q	1.59E+01	1.10E-01	mg/Kg	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Sediment	ID+Q	3.71E+03	1.10E-01	mg/Kg	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Sediment	ID+Q	1.59E+02	1.10E-01	mg/Kg	SW-846 8270C
Benzoic acid	65-85-0	Y	Sediment	ID+Q	6.12E+05	5.50E-01	mg/Kg	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Sediment	ID+Q	4.59E+04	1.10E-01	mg/Kg	SW-846 8270C
Biphenyl	92-52-4	Y	Sediment	ID+Q	1.10E+00	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Sediment	ID+Q	1.29E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Sediment	ID+Q	4.95E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Sediment	ID+Q	2.03E+02	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Sediment	ID+Q	1.82E-01	2.20E-02	mg/Kg	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Sediment	ID+Q	1.10E+01	1.10E-01	mg/Kg	SW-846 8270C
Caprolactam	105-60-2	Y	Sediment	ID+Q	7.65E+04	2.20E-01	mg/Kg	SW-846 8270C
Carbazole	86-74-8	Y	Sediment	ID+Q	7.10E+02	1.10E-01	mg/Kg	SW-846 8270C
Chrysene	218-01-9	Y	Sediment	ID+Q	3.84E-01	1.10E-01	mg/Kg	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Sediment	ID+Q	6.34E-02	2.20E-02	mg/Kg	SW-846 8270C

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Dibenzofuran	132-64-9	Y	Sediment	ID+Q	2.00E+00	1.10E-01	mg/Kg	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Sediment	ID+Q	6.30E-01	1.10E-01	mg/Kg	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Sediment	ID+Q	1.22E+05	1.10E-01	mg/Kg	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Sediment	ID+Q	1.10E+01	1.10E-01	mg/Kg	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Sediment	ID+Q	3.06E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluoranthene	206-44-0	Y	Sediment	ID+Q	6.00E-01	1.10E-01	mg/Kg	SW-846 8270C
Fluorene	86-73-7	Y	Sediment	ID+Q	1.90E-02	1.90E-02	mg/Kg	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Sediment	ID+Q	8.88E+00	1.10E-01	mg/Kg	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Sediment	ID+Q	9.19E+02	1.10E-01	mg/Kg	SW-846 8270C
Hexachloroethane	67-72-1	Y	Sediment	ID+Q	1.00E+00	1.10E-01	mg/Kg	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Sediment	ID+Q	1.59E+01	1.10E-01	mg/Kg	SW-846 8270C
Isophorone	78-59-1	Y	Sediment	ID+Q	1.50E+04	1.10E-01	mg/Kg	SW-846 8270C
Nitrobenzene	98-95-3	Y	Sediment	ID+Q	7.65E+01	1.10E-01	mg/Kg	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Sediment	ID+Q	1.07E+00	1.10E-01	mg/Kg	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Sediment	ID+Q	6.31E-01	2.20E-02	mg/Kg	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Sediment	ID+Q	9.01E+02	1.10E-01	mg/Kg	SW-846 8270C
o-Cresol	95-48-7	Y	Sediment	ID+Q	7.65E+03	1.10E-01	mg/Kg	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Sediment	ID+Q	5.61E+01	5.50E-01	mg/Kg	SW-846 8270C
Phenanthrene	85-01-8	Y	Sediment	ID+Q	2.40E-01	2.20E-02	mg/Kg	SW-846 8270C
Phenol	108-95-2	Y	Sediment	ID+Q	4.59E+04	1.10E-01	mg/Kg	SW-846 8270C
Pyrene	129-00-0	Y	Sediment	ID+Q	6.65E-01	1.10E-01	mg/Kg	SW-846 8270C
Pyridine	110-86-1	Y	Sediment	ID+Q	7.35E+02	1.10E-01	mg/Kg	SW-846 8270C

Notes:
NV - No value established